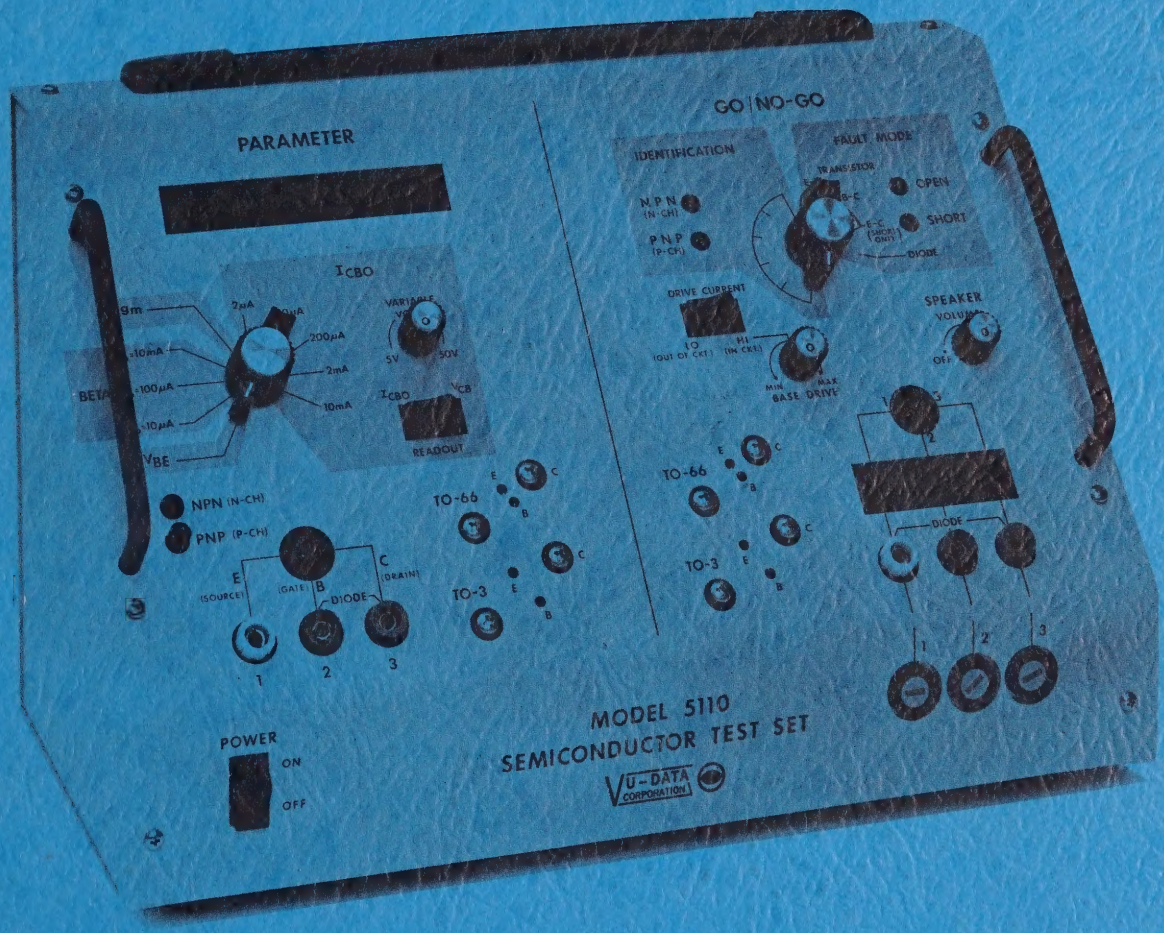
VU-DATA CORPORATION

TECHNICAL MANUAL

OPERATION
APPLICATION
MAINTENANCE



MODEL 5110
SEMICONDUCTOR TEST SET

PUBLICATION NO. 4-20413

WARRANTY AND ASSISTANCE

WARRANTY

VU-DATA warrants to the original Buyer of goods of VU-DATA design and manufacture for a period of one (1) year from the date of shipment from VU-DATA that the goods under the order will be of merchantable quality free from defects in material, workmanship and design each as determined at the date of shipment by VU-DATA. VU-DATA will not be liable for any design or design modification requested by or furnished by Buyer and incorporated into the goods.

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CALL (619) 279-6572.

When information, assistance or authoriazation is required refer to the serial number on the back of the unit when contacting VU-DATA.

MODEL 5110

Serial Number _____

TECHNICAL MANUAL

OPERATION
APPLICATION
MAINTENANCE

PREFACE

This manual contains the information required by personnel at all levels of involvement to understand the functions, internal operation, application, and maintenance requirements of the Vu-Data Model 5110 Semiconductor Test Set.

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WARNING

Before removing the covers for trouble shooting, read and observe the trouble shooting precautions on page 29. Circuits are exposed which could become hazardous if not handled properly.

CAUTION

ALWAYS remove the AC power cord from the connector on the rear panel before removing back and/or bottom covers. The interior of this instrument contains voltage levels which could be hazardous to your health. AC power lines exposed when covers are removed.

CAUTION

NEVER apply power to device or P.C. board being tested while connected to the Model 5110. All STS testing of in-circuit components MUST be performed with no circuit power applied.

CAUTION

Avoid the use of chemical cleaning agents such as MEK, laquer thinner, or strong acids or alkali. These solvents will cause paint removal, deterioration of switches and melting of plastic parts.

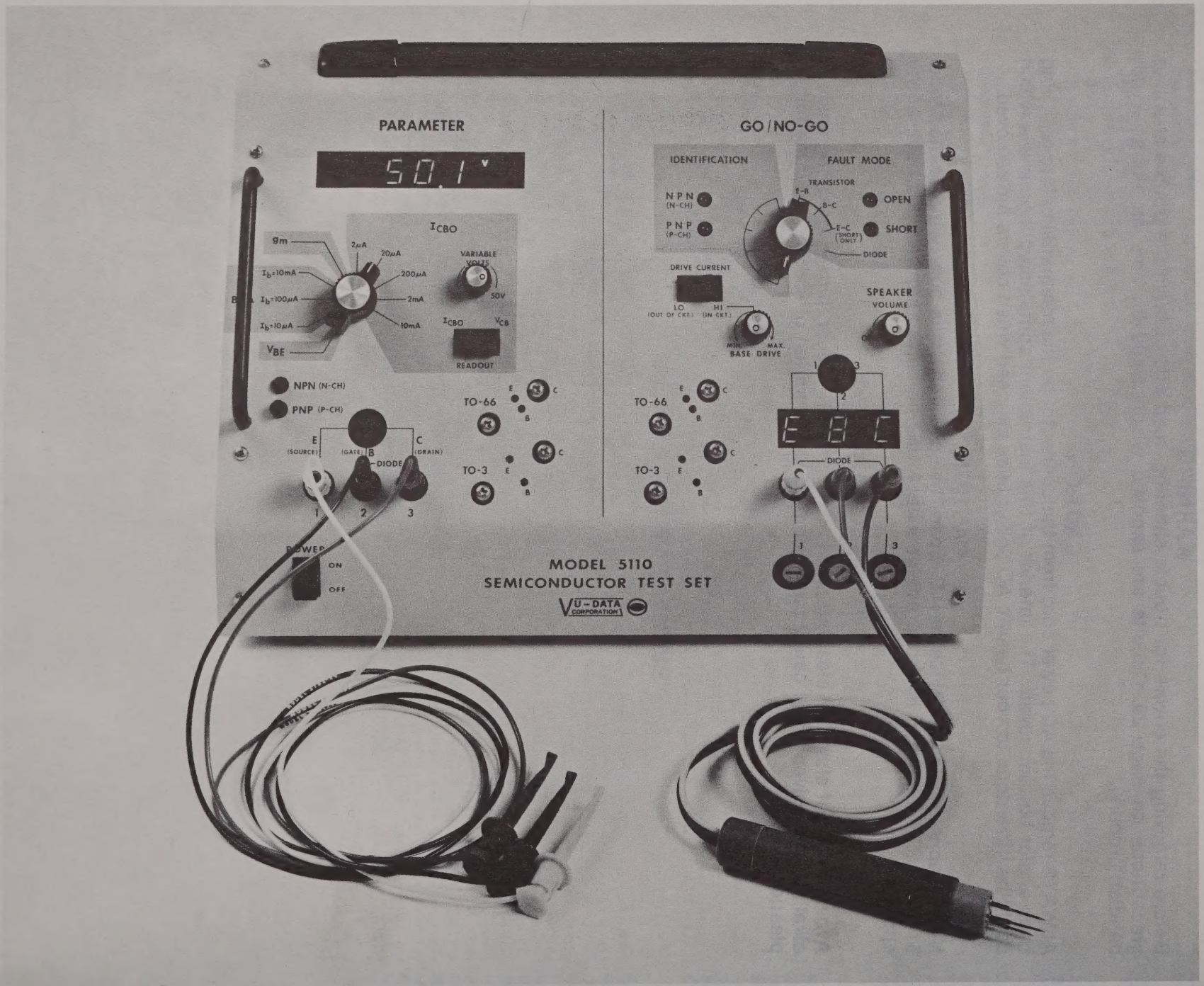


Figure 1. Model 5110 Semiconductor Test Set

This manual provides information relative to the use of the Model 5110 SEMICONDUCTOR TEST SET (STS) manufactured by VuData Corporation, 7122 Convoy Court, San Diego, California 92111. The Model 5110 is shown in Figure 1.

This manual contains complete operation, application, calibration, troubleshooting, and maintenance information required by the user or service technicians in the operation or servicing of the Model 5110 and is presented as follows:

Introduction
Preparation For Use
Theory of Operation
Operating Instructions
Applications
Troubleshooting
Calibration
Maintenance and Service
Parts Listing
Drawings

General Description

The Model 5110 STS is a portable "general purpose" type of instrument used as an in-circuit or out-of-circuit semiconductor tester. The Model 5110 is a single unit suitable for bench-top use. Four rubber feet are provided on the bottom of the unit. A front panel is angled for improved visibility and ease of operation. All controls for the STS are front panel mounted for operator convenience.

The Model 5110, provides a simple, sure and inexpensive way to detect defective semiconductors in-circuit or out-of-circuit, without the need of circuit power. The STS provides all the circuitry required for even the most inexperienced user to effectively determine "*Good*" or "*Bad*" components, while providing a high level of sophisticated testing for the experienced technician or engineer where required.

The test set has plug-in sockets for TO-3, TO-5 and TO-66 type semiconductors. Three fused jacks are provided for testing of other types of semiconductors and diodes for in-circuit-testing of semiconductors using mini-grabbers or the three-prong test probe.

The 5110 uses a high-current, low duty cycle pulse technique to test transistors. An electronic switching circuit is used to enable the user to identify the terminals of the device-under-test (D.U.T.) in most in-circuit tests and all out-of-circuit tests.

Circuitry is provided for out-of circuit measurement of transistor beta and FET g_m, and the testing of high current devices at rated current (up to 2 amperes) without over-dissipation and leakage.

The instrument is designed for ease of operation, with a minimum of control functions, allowing faster and easier testing of large quantities of parts.

Package Size

The Model 5110 is a compact 8.5 inches high by 12.5 inches wide by 6.5 inches in depth. The instrument case is of aluminum. A power plug and fuse holder are located on the rear panel.

Features

- A 10-position Identification/Fault Mode switch sequentially connects the device-under-test in all possible configurations making it unnecessary to know the device terminal identification. Lead identification is displayed on 3-Seven segment displays. (i.e., E-B-C).
- HI-LO Switch for Drive Currents.
- Automatic polarity indication of NPN or PNP devices and N-channel or P-channel FET's.
- Adjustable Audible Tone tells when the DUT is good—no need for visual check of instrument. Volume control allows for varying of signal to working conditions.
- Measures beta of low-power and high-power transistors in 3 ranges.
- Measures g_m in 1 range.
- Measures I_{CBO} in 5 ranges.
- Automatic current limiting of DUT.

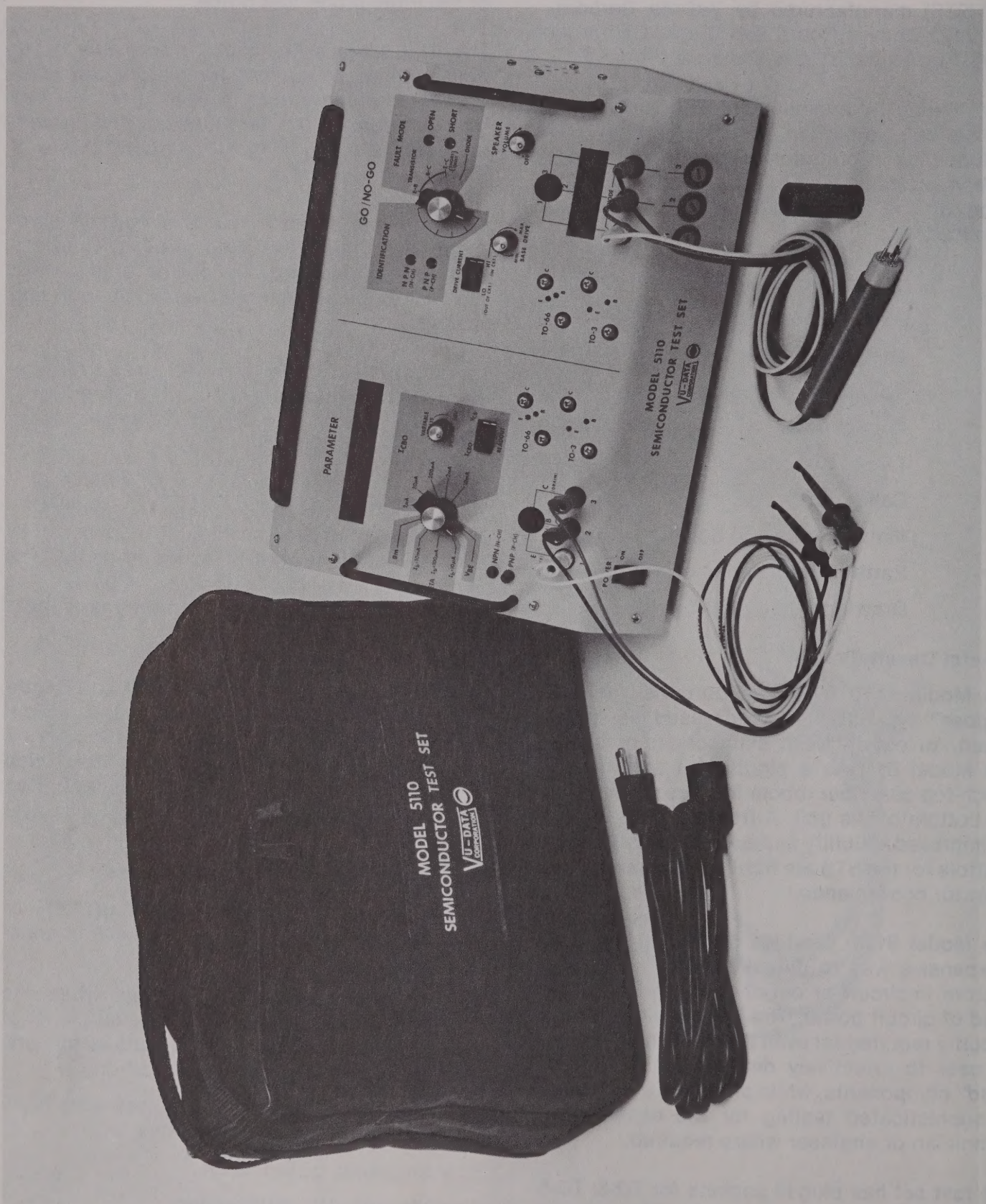


Figure 2. Model 5110 and Accessories

- Digital Read-out of current, voltage, beta and g_m.
- Identifies device as silicon or gemanium.
- Switch for current/voltage comparision of collector/base (I_{CBO} and V_{CB}).
- Choice of test leads or 3 separte types of front panel sockets for out-of-circuit tests.
- Fused test leads for positive connection to devices in different locations. Go/No-Go section only.

Capabilities of the Model 5110

- Determines GOOD or BAD transistors or FET's in- or out-of-circuits.
- Determines GOOD or BAD diodes in- or out-of-circuit.
- Identifies fault of bad device (Open, Short)
- Identifies leads of transistors and displays findings as E-B-C on seven segment displays.
- Identifies gate lead of FET.
- Indicates polarity of good devices (NPN or PNP; N or P channel FET's).
- Identifies Cathode-Gate-Anode leads of SCR's.
- Identifies Cathode of Diodes.
- Measures breakdown and leakage parameters of transistors.
- Tests all types except triacs, diacs and diode arrays.

Items Furnished

The Model 5110 comes complete with the following items:

a) One 6-foot 3-wire Power Cord PN-2-70009

b) One Technical Manual PN-4-20413

c) One TEST LEAD SET containing: 3 mini-grabbers PN-4-20415

d) One Probe PN-4-20414

e) One carrying case P/N51102020

Associated Equipment

To further enhance the component testing level, Vu-Data also provides the Model 3110 In-Circuit Component Tester and the Model 3120 IC Test Fixture. The Model 3110 is a portable "special purpose" type of oscilloscope and signal processing instrument that is used as an in-circuit component tester providing a simple and inexpensive way to detect defective components in-circuit or out-of-circuit, without the need of circuit power. When users of the Model 3110 asked for an even easier way to test integrated circuits (IC's), the Model 3210 was designed to meet this need. Although the Model 3210 was designed to operate with the Model 3110 for good-bad-no-power comparison tests, its versatility also allows it to be used with a dual trace oscilloscope like Vu-Data's Model 975 or a DVM to compare waveforms or voltages on any pin of an IC (from 1-40) in an operating circuit. Tests of IC's having 8 to 40 pins are accomplished WITHOUT having to reverse the IC.

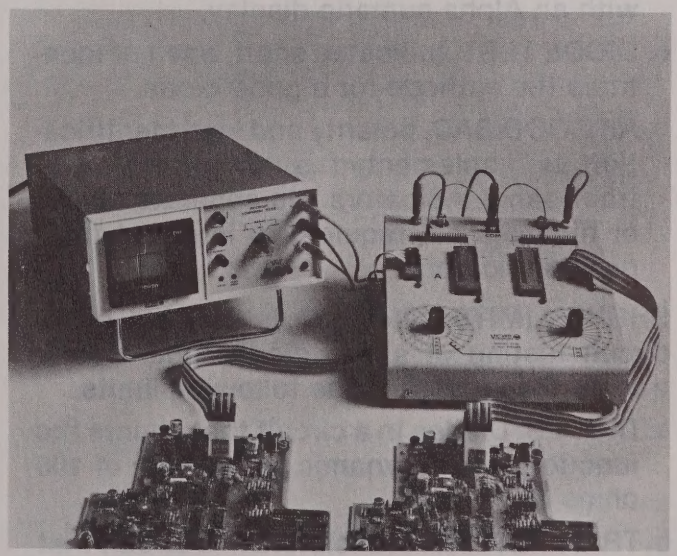


Figure 3. Model 3110 and Model 3210

SPECIFICATIONS

GENERAL. The Model 5110 is a solid state semiconductor analyzer capable of both in-or out-of-circuit GO/NO-GO testing and out-of-circuit Parameter testing.

CLASSIFICATION. The Model 5110 is Type III, Class 5, Style E, and Color R for Navy applications in accordance with MIL-T-28800 with the following exceptions:

a. The relative humidity requirement is limited to 45% during leakage current measurements.

b. The pulse shock testing requirement is not invoked.

c. The EMI requirement is not invoked.

d. The 400 Hz nominal power requirement is not invoked.

OPERATIONAL CHARACTERISTICS

LEVEL 1 AND 2. The Model 5110 is capable of testing semiconductors either out-of-circuit or in-circuit with circuit power removed. A selector switch for HI-LO drive currents is provided with the shunt limits listed below.

a. GO CONDITION (IDENTIFICATION MODE). A good device will be identified as to Good or Bad, type (NPN or PNP) and the Lead orientation indicated with an Alpha-numeric display.

b. NO-GO CONDITION (FAULT MODE). A bad device will be indicated as OPEN or SHORT and the junction involved will be identified with an Alpha-numeric display.

c. DIODE TEST. Indicates short, open or identifies the cathode for a good diode.

All GOOD/BAD, polarity and lead identification is implemented automatically with front panel indicators. No separate charts or manuals are required to interpret front panel indicators.

SHUNT LIMITS. The 5110 is capable of in-circuit testing of signal diodes and bipolar transistors subject to the following limits.

a. DIODES. Diodes in a circuit that shunts the junction with a dynamic impedance of **100** ohms or more.

b. TRANSISTORS. Transistors in a circuit that presents a dynamic impedance of:

(1) Base to Emitter of **100** ohms or more.

(2) Base to Collector of **100** ohms or more.

(3) Collector to Emitter of **25** ohms or more.

LEVEL 3 PARAMETER. The Model 5110 will perform the following out-of-circuit, dynamic parameter measurements:

a. BETA, from 0 to 1,999 using 3 separate base drive currents. Base drive is a 2% duty cycle pulse 300 μS wide.

b. Collector-To-Base Leakage Current, I_{CBO}, from less than 100 nA to 10 mA in 5 ranges with 10 nA resolution on the most sensitive rage. Bias voltage is continuously variable from 5 volts to 50 volts.

c. Base-to-Emitter saturation voltage, $V_{BC\ (SAT)}$, over a range of 0 to 1.999 volts full scale with a resolution of 0.005 volts or less.

d. FET Transconductance (Gm) from 0 to 19.99 m℧ (milli-mhos).

e. SEMICONDUCTOR COMPOSITION. The Model 5110 will identify the semiconductor material composition as either silicon or germanium with a front panel readout of "SI" or "GE".

f. BIAS CURRENT RANGES. In the Beta Mode, peak base currents of 10 μA, 100 μA and 10 mA are provided.

g. ACCURACY. The accuracy of all parameter measurements made by the Model 5110 is ±(3% of reading + 10 digits) for any mode or range.

INDICATORS. The Model 5110 uses LED digital readouts and annunciators for parameter measurements, LED indicators for GO/NO-GO, polarity and fault indicators, and LED digital alpha-numeric identification of device leads in GO/NO-GO testing. A selectable audio indicator with variable volume is provided in GO/NO-GO testing.

EQUIPMENT PROTECTION. The Model 5110 input jacks used for in-circuit GO/NO-GO testing are capable of withstanding up to 600 [redacted] Vrms without damage to internal circuits. Protection fuses for the 3 leads are mounted in standard front panel accessible fuse holders.

TEST SOCKETS. The 5110 is provided with front panel mounted test sockets for TO-5, TO-66 and TO-3 case configurations in addition to the input banana jacks. Separate sockets are provided for the GO/NO-GO and parameter test sections. The sockets provided are specially designed for test applications to provide a high number of insertions.

POWER. The Model 5110 is powered in accordance with the nominal power requirements of MIL-T-28800 except operation from 400 Hz source power is not provided. The maximum power required for operation shall not exceed 20 watts.

PROTECTIVE CASE. A carrying case is provided to store all components of the test set and to protect them against the normal shock, vibration, and other environmental conditions encountered during use in more than one location. This protection shall be in accordance with the environmental requirements of Class 5 of MIL-T-28800.

ACCESSORIES. The following accessories are provided with each Model 5110.

a. One 3-prong test probe with a 5-foot cable.

b. One set of semiconductor sockets.

c. One spares kit of replacement fuses.

d. Three color coded "mini-grabber" test leads.

e. A complete operator/maintenance manual with description, operating instructions, calibration procedures, schematic, and parts information.

CALIBRATION INTERVAL. After calibration, the Model 5110 will maintain the specified tolerance for a period of at least 1 year.

RELIABILITY. When invoked, reliability verification testing for the Model 5110 will comply with Type III, Class 5 environmental conditions of MIL-T-28800. MTBF is more than 2000 hours.

ELAPSED TIME INDICATOR. The Model 5110 is provided with an internally mounted, replaceable, minaturized, solid-state elapsed time indicator (ETI) capable of measuring and directly indicating the actual time that the equipment is in an operating condition. With the exception of mounting configurations, the ETI shall meet or exceed all requirements invoked by MIL-I-81219 for nonmercuriac indicating cells. The time range full-scale reading shall be 5000 hours.

DIMENSIONS AND WEIGHT. The size and weight of the Model 5110 is consistant with commercial capabilities and does not exceed the maximum dimensions for shipboard applications. Instrument dimensions are 12.5″ wide by 8.5″ high by 6.5″ deep. Weight is less than 7 pounds. The carrying case is 14″ wide by 9.5″ high by 8″ deep. Weight of carrying case and accesories is less than 2 pounds.

Acceptance of Delivery

Prior to accepting delivery, a careful inspection of the shipping container must be made. A severe gouge, abrasion or scratch; a badly battered corner or edge constitutes evidence of mishandling that may have damaged the unit. If there is any damage to the shipping container, a note of such must be signed by the carrier's representative acknowledging the damage before delivery can be accepted.

NOTE

In preparing to unpack the unit, provisions should be made to retain the shipping container and packing material for use in the event that is should become necessary to repack the unit for shipment to another installation or to return it to the factory.

A visual inspection for damage should be accomplished upon removing the instrument from the shipping container. If damage is not apparent until the instrument is unpacked, a claim for concealed damage should be placed with the carrier within 15 days of receipt. All shipping containers and filler materials must be kept for inspection.

Receiving Inspection

Whether or not any damage to the shipping container was noted, a thorough inspection of the unit is essential prior to application of power. Visually examine the:

- Cover for dents or abrasions
- Carrying case for damage
- Control panel for broken knobs or damaged switches
- Rear panel for damage to fuse holder or connector
- Lower front panel for broken knob, switches or fuse holders

If any scratches, abrasions, dents, bulges, cracks or other evidence of damage is noted, notify Vu-Data Corporation, Customer Service Department immediately. Call (169) 279-6572.

NOTE

To avoid cancellation of the warranty, do not apply power to a unit that has been dropped or damaged. Notify Vu-Data, requesting information as to disposition of damaged unit.

Reshipment

When reshipment of a Model 5110 becomes necessary, it should be packed in the original container in accordance with the following procedure:

1. Remove power cord and test leads.
2. Place cords in protective pocket of carrying case.
3. Place unit/carrying case in plastic bag.
4. Place unit in container.
5. Place lid on container.

Power Requirements

The Model 5110 input power requirements are 115 Vac, ±10%, 50-60 Hz, 20 Watts maximum

First Time Operation

1. Connect the power cord to the connector on the rear panel.
2. Connect plug to 3-prong grounded AC receptacle.
3. Depress POWER rocker switch on lower front panel.
4. Observe indicators are illuminated.

Allow instrument to warm up for approximately two minutes before using. For use, follow operating instructions provide in this manual.

Function Checkout Procedures

The Model 5110 Semiconductor Test Set was aligned, calibrated and tested prior to shipment. The instrument is therefore ready for immediate use upon receipt. If the unit has passed receiving inspection, then the following function checkout tests may be performed.

NOTE

The Model 5110 is furnished with a detachable 3-prong power cord that grounds the chassis in accordance with NEMA recommendations to protect operating personnel from shock hazards. When plugged into an appropriate power source, the fused power input conforms to applicable safety standards. If it is necessary to operate the unit from a two-prong facility receptacle, the grounding feature should be retained by using a suitable 3-prong to 2-prong adapter and grounding the pigtail lead to the adapter.

TEST PROCEDURE

a) Connect the power cord to the connector on the rear panel.
Connect plug to AC outlet.
Depress power switch on front panel.
Observe front panel indicators are illuminated.

b) Allow two minutes for the instrument to warm up, then set the front panel controls as follows:

Identification/Fault Sw.....Pos 1
Drive Current.....LO
Parameter Sw.....V_{BE}
NPN/PNP ..... NPN

OBSERVE
"E-B-C" in the Lead window is illuminated.
"Si" and "I" and "V" in the Parameter readout are illuminated.
NPN, PNP, OPEN and SHORT are OFF.

c) Slowly rotate Identification Switch and observe the following.

SWITCH POS	LEAD WINDOW INDICATORS
POS 1	E-B-C
2	C-B-E
3	B-C-E
4	B-E-C
5	C-E-B
6	E-C-B

OBSERVE
While rotating switch in test above that the following indicators remain OFF.
NPN, PNP, OPEN and SHORT.

d) Rotate switch to FAULT MODE (Position 7).

OBSERVE
EB__ in the lead window and the OPEN indicators are illuminated.
The SHORT indicator is OFF.

e) Insert a short length of wire into the transistor socket pin 1 and the other end in pin 2 (emitter and base) shorting the two pins.

OBSERVE
The OPEN indicator is OFF.
The SHORT indicator is illuminated.
Remove wire, indicator should revert to original state.

f) Move switch to Position 8.

OBSERVE
The __BC lead window indicators are illuminated.
The OPEN indicator is illuminated.
The SHORT indicator is OFF.

g) Insert wire into pin 2 of the transistor socket and the other end into pin 3 (base, collector) shorting the pins together.

OBSERVE
The OPEN indicator is OFF.
The SHORT indicator is illuminated.
Remove wire, indicators should revert to original state.

h) Move switch to Position 9.

OBSERVE
The E__C Lead window indicators are illuminated.
The OPEN indicator is OFF.
The SHORT indicator is OFF.

i) Insert wire into transistor socket pin 1 and the other end into pin 3 (emitter, collector).

OBSERVE
The SHORT indicator illuminates.
Remove wire and indicator should revert to original state.

j) Move switch to Position 10.

OBSERVE
The Lead window indicator is OFF.
The OPEN indicator is illuminated.
The SHORT indicator is OFF.

k) Insert wire into pins 1 and 3 shorting pins.

OBSERVE
The OPEN indicator is OFF.
The SHORT indicator is illuminated.
The Lead window indicator is OFF.

Remove wire. This completes the test of the GO/NO-GO section. Rotate Identification switch to Position 1.

The next section will test the Parameter side of the instrument. To do this test you will need a 2N3904 transistor or equivalent.

a) Verify

a) Parameter Switch set at.....V_{BE}

b) NPN/PN— Switch set at .....NPN

b) Insert a 2N3904 or equivalent silicon transistor into the TO-5 socket observing proper pin configuration.

NOTE

When using the parameter section the DUT must be properly installed in accordance with the front panel labeling. If you are in doubt as to the correct arrangement of the DUT install it in the TO-5 socket on the GO/NO-GO section first to determine lead configuration.

OBSERVE
Display should show:

Si .750 V

This tells us the device is a silicon transistor with a V_{BE} of 0.750 volts.

c) Move switch to the second position (I_b = 10 μA).

OBSERVE
The display reads between:
100 to 200
This is a ratio of the collector current to the base current or Beta.

d) Move switch to the next postion (I_b = 10 μA).

OBSERVE
Display reads between:
100 to 200

e) Move switch to the next position (I_b = 10 mA).

OBSERVE
Display reads approximate 25.

This completes test. Return switch to the V_{BE} position.
Remove transistor and secure test set.

Introduction

The Model 5110 Semiconductor Test Set is a portable general purpose type of instrument designed as an in-circuit or out-of-circuit semiconductor tester. As the name implies, the Semiconductor Test Set has the capability to test most transistors, FET's and diodes, with the only exceptions being triacs, diacs and diode arrays. The instrument is basically divided into two sections, a GO/NO-GO Section and a Parameter Section. Both sections could be used at the same time if required. The only common tie between the two is the power supply.

The Model 5110 circuitry is contained on three (3) printed circuit boards as shown in figure .

1. **The Power Supply Board (51105001)** located in the bottom of the instrument.
2. **The Panel Board (51105003)** located behind the front panel.
3. **The Switch Board (511005002)** located on the side of the instrument and positioned vertically.

The three boards are interconnected with ribbon cable, with a 20-pin ribbon cable between the panel board and the power supply board, and a 15-pin ribbon cable between the panel board and the switch board. Addition wiring external to the boards consists of AC wiring to the AC connector, fuse and power switch, and the audio control and output.

The wiring diagram is Drawing No. 51101004.

The schematics are as follows:

Schematic	Dwg. Number
Power Supply	51101001
Switch Board	51101002
Panel Board, Parameter	51101003, sh 1
Panel Board, GO/NO-Go	51101003, sh 2

Go/No-Go Section

The Model 5110 provides all the circuitry required to effectively determine GOOD or BAD components, determine automatic polarity indications of NPN or PNP devices or N-channel or P-channel FET's. The unit also provides positive lead identification. A GO/NO-GO subsystem block diagram is shown in Figure 5.

Parameter Section

The parameter side of the instrument provides the display and controls necessary for the measurement of transistor beta and FET g_m. It also measures base-emitter voltage ($V_{BE(SAT)}$) and identifies the device-under-test as silicon (Si) or germanium (Ge). A display is provided at the top of the unit to display the readings. The Model 5110 also measures I_{CBO} in five ranges. A switch is provided called "Readout I_{CBO}/V_{CB}" for current/voltage comparisons of collector/base current voltage relationships.

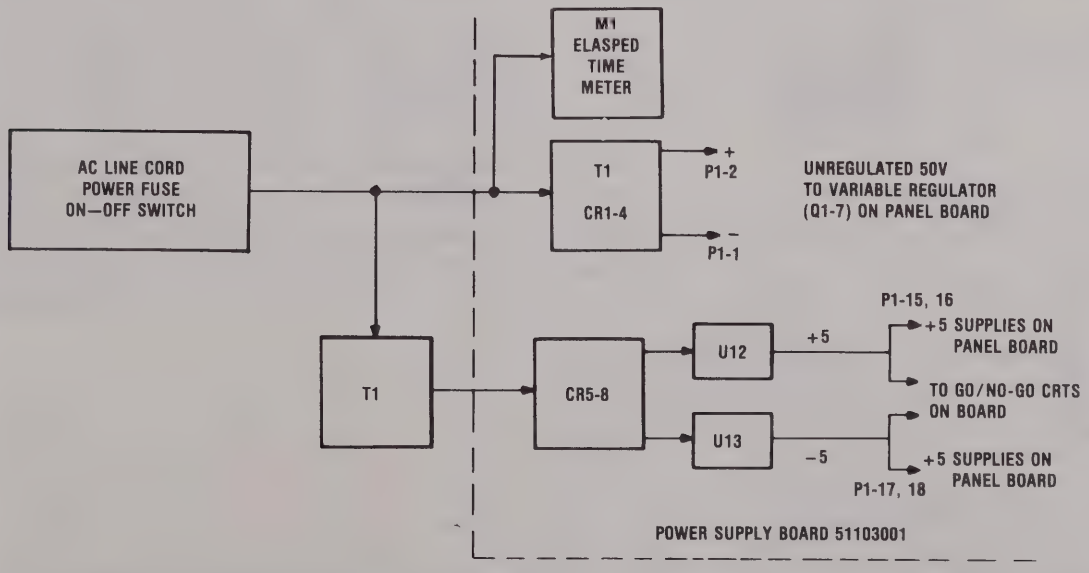


Figure 4. Power Supply Block Diagram

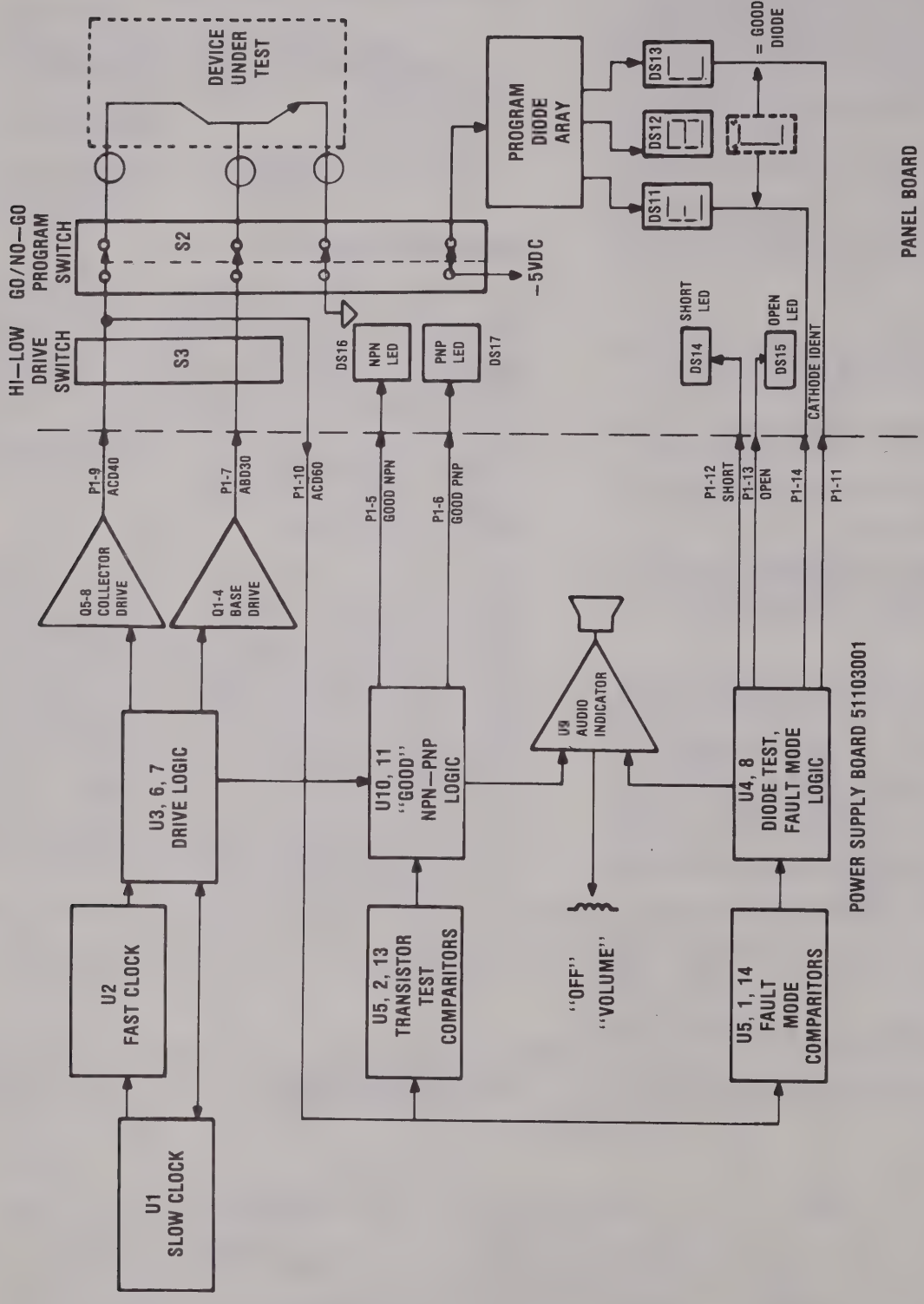


Figure 5. Go/No-Go Block Diagram

$V_{BE\,(SAT)}$ and Si/Ge Indentification

When the parameter test switch is in the V_{BE} position (position 1) the D-U-T (transistor) is biased as a saturated switch with I_b = 1 mA and I_c = 10 mA. Figure 6 shows the simplified circuitry for V_{BE}. The digital voltmeter (DVM) reads the saturated base-emitter voltage (V_{BE}). This signal (sense) is also applied to the Si/Ge logic as shown in figure 7 below. The comparators (U4) are LM339, which feature open collector outputs used in the wired — OR configuration. The Ge and Si are appropriately decoded by U3 to light the proper LED bar to display either.

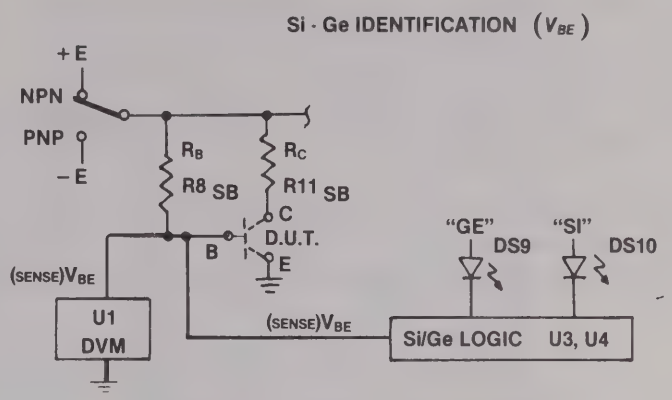
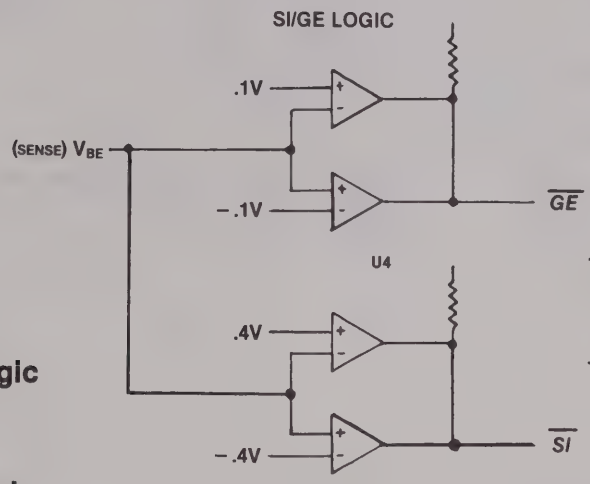


Figure 6. Si-Ge Identification



READ OUT	CONDITION	$\overline{GE}$	$\overline{SI}$
BLANK	$\lvert V_{BE}\rvert < 2V$	*H*	*H*
Ge	$.1V < \lvert V_{BE}\rvert < .4V$	L	H
Si	$.4V < \lvert V_{BE}\rvert$	L	L

Figure 7. SI/Ge Logic

Beta Measurement

Depending upon the type of transistor under test the bi-directional current source (Q4, Q5, Q6, Q7) either sources or sinks current to the "base" of the D.U.T.

The 2% Duty Cycle Switch Drive (U2, U3) causes the transistor switch (Q1, Q2) to "OPEN" and the FET switch (Q3) to "CLOSE" for 300 μSec every 15 mSec, biasing the D.U.T. "ON". The voltage across R_{SENSE} (R14-17) is proportional to the D.U.T. collector current. The magnitude of the base drive current is a multiple of '1' allowing the system to be easily scaled (R_{SENSE} is also a multiple of '1').

The use of the 2% duty cycle technique is similar in concept to the methods used by manufacturers to characterize and measure the "pulsed H_{FE}" specifications.

The FET switch (Q3) and capacitor "C" (C11), constitute a very simple sample and hold circuit for the DVM (U1).

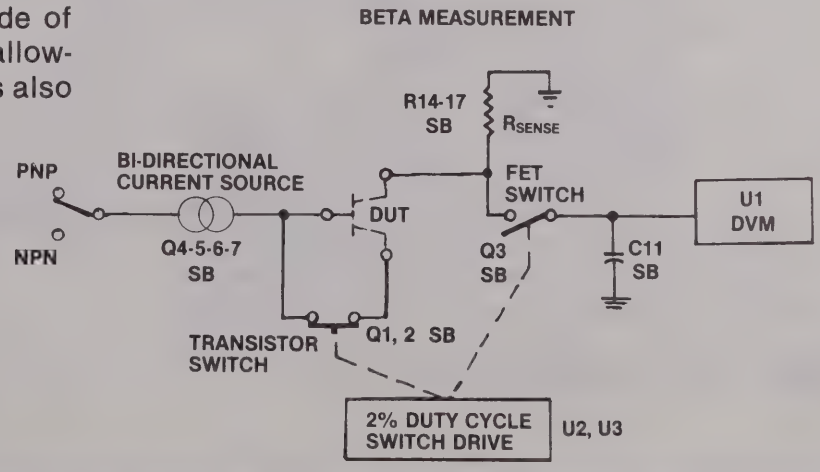


Figure 8. Beta Measurement

g_m Measurement

The FET is biased in a zero gate-source voltage mode, a normal condition for the measurement of g_m. The Vgs = 0 condition is assured by R_G (R12 on the Switch Board) connected between the source and the gate.

A 1kHz sine wave (generated by U5, Q25, Q26, Q27) of 100 mV amplitude is a.c. coupled to the D.U.T.'s (FET) gate. The signal at the drain is:

$$e_d = g_m \quad e_g = g_m\,(100\text{ mV})$$

$$\text{so,} \quad g_m = \frac{e_d}{100\text{ mV}}$$

The precision rectifier (U1, U2 on the Switch Board), sometimes called an a.c. converter circuit, rectifies, filters and scales e_d to be read by the DVM. Since the precision rectifier is a.c. coupled, it detects only the a.c. signal, thereby providing the dynamic parameter g_m (sometimes called g_{fs} by manufacturers).

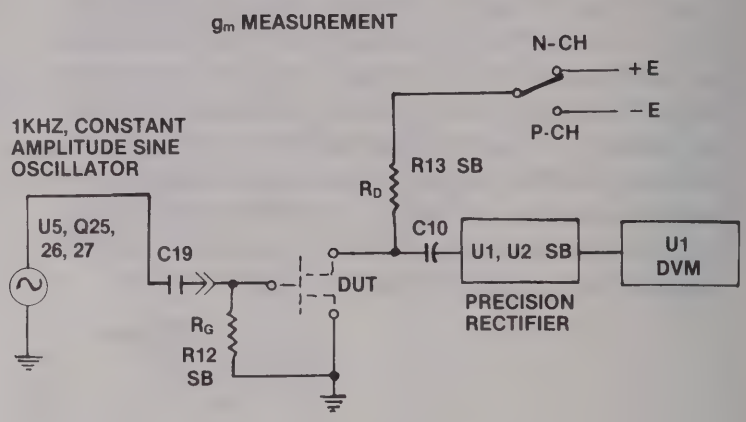


Figure 9. g_m Measurement

I_{CBO} Measurement

The variable power supply, E_{VAR}, (comprised of Q1-7, R59, R60) has a range from 3VDC to 50VDC. A variable current limit "ganged" with the voltage control approximates a constant power function.

i.e., As the voltage output of the supply is increased, the available current is decreased thereby limiting the maximum power from the supply to approximately 50 mW.

The HI-Z Amplifier (U3 on the Switch Board) uses a low-offset operational amplifier in a non-inverting configuration to buffer R_{SENSE} (R3-7 on the Switch Board) and provides a gain of 10 to the voltage across R_{SENSE}. Since the higest value of R_{SENSE} is 100K, the input impedance of the HI-Z Amplifier must be at least 2×10^9 ohm to prohibit detectable loading. The DVM (U1) can be switched to read applied voltage or I_{CBO}.

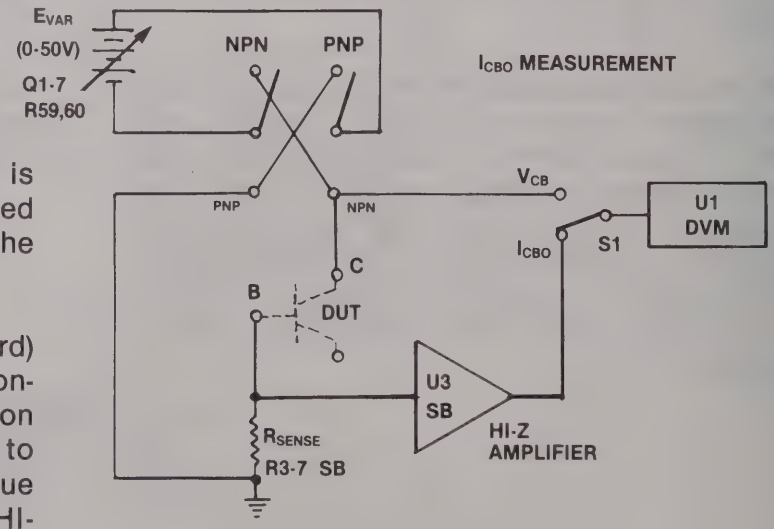


Figure 10. I_{CBO} Measurement

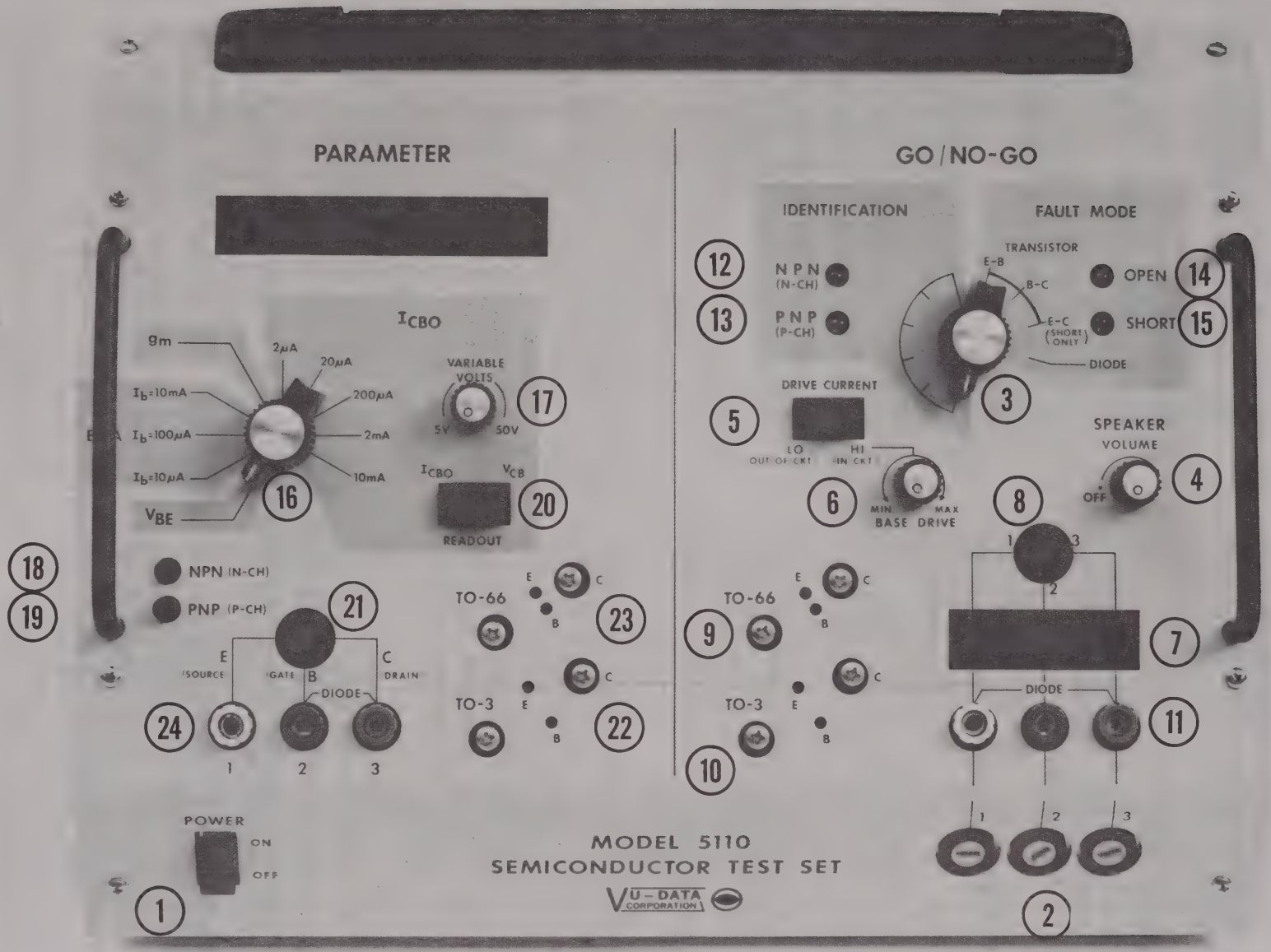


Figure 11. Controls and Indicators

Base Controls

1. POWER ON/OFF SWITCH — Turns unit power on or off.
2. FUSE HOLDERS (3) provide protection on the 3 test leads for the GO/NO-GO SECTION ONLY.

Go/No-Go Section Only

3. IDENTIFICATION/FAULT MODE SWITCH — Selects proper device connections for testing and lead identification. (10 positions).

Position	Identification	
1	E-B-C	
2	C-B-E	Transistor
3	B-C-E LEAD	NPN,
4	B-E-C Identification	PNP =
5	C-E-B	GOOD
6	E-C-B	
7	E-B __ Open/short	Transistor
8	__ B-C Junction Test	Fault Mode
9	E __ C Short only Junction Test	
10	C __ __ or Open/short and __ __ C Cathode Identify	Diode Test

4. AUDIO KNOB — turns audio tone ON/OFF and adjust volume to desired level in GO/NO-GO SECTION.
5. LO/HI Switch — Selecting drive level required for the identification test.
6. BASE DRIVE KNOB — In HI, varies Base Drive current from approximately 10 mA (min) to approximately 100 mA (max).
7. LEAD WINDOW — 7 segment displays (3) provide lead identification to sockets.
8. TO-5 TEST SOCKET — Out of circuit tests can be performed by inserting the semiconductor into socket. The terminals are internally connected in parallel with those of Test lead sockets. (11)
9. TO-3 Test Socket — Same.
10. TO-66 Test Socket — Same.
11. Test Lead Sockets (3) — These sockets are receptacles for the test leads provided with the STS. Fused inputs. Protect against connection to a live circuit.
12. NPN INDICATOR — LED indicator lights when an NPN transistor or N-channel FET test GOOD.
13. PNP INDICATOR — LED indicator lights when a PNP transistor or P-channel FET test GOOD.
14. OPEN FAULT INDICATOR — LED indicator lights to indicate an OPEN condition in DUT.
15. SHORT FAULT INDICATOR — LED indicator lights to indicate a SHORT condition in DUT.

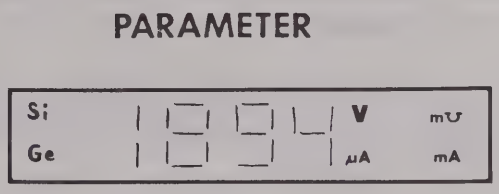
Parameter Test Section

16. PARAMETER TEST SWITCH — 10 position rotary switch for selection of test par.

Position		
1	$V_{BE\,(SAT)}$	
2	I_b = 10μA	Beta
3	I_b = 100μA	Beta
4	I_b = 10mA	Beta
5	20mσ- g_m	
6	2μA	I_{CBO}
7	20μA	I_{CBO}
8	200μA	I_{CBO}
9	2mA	I_{CBO}
10	10mA	I_{CBO}

17. VAR VOLTS KNOB — In I_{CBO}, varies the voltage applied to DUT from 5 to 50V, also varies the current limiter from 10mA at 5V to 1mA at 50V.
18. NPN PUSHBUTTON —
19. PNP PUSHBUTTON — MUST be set to type of DUT for all parameter tests.
20. I_{CBO}/V_{CB}ROCKER SWITCH — changes display to a readout of volts applied or leakage current.
21. TO-5 TEST SOCKET — Out of circuit tests can be performed by inserting the semiconductor into socket. The terminals are internally connected in parallel with those of Test lead sockets. (24)

22. TO-3 Test Socket (see 21).
23. TO-66 Test Socket (see 21).
24. Test Lead Sockets — can be used with mini-grabber to connect to a device with short or bent leads.



Display

Si — In V_{BE}, junction measured is silicon device.

GE — In V_{BE}, junction measured is germanium device.

V — Volts (V_{BE}), (I_{CBO}-volts).

m℧— Milli-MHOS (g_m).

μA — Micro Amps ($A \times 10-6$) I_{CBO}.

mA — Milli Amps ($A \times 10-3$) I_{CBO}.

3½ digit LED display with floating decimal point.

A display of 1-blank-blank-blank indicates an overrange condition.

— CAUTION —

NEVER APPLY POWER TO DEVICE OR P.C. BOARD BEING TESTED WHILE CONNECTED TO THE MODEL 5110 STS

ALL **STS** TESTING OF IN-CIRCUIT COMPONENTS MUST BE PERFORMED WITH **NO CIRCUIT POWER** APPLIED

Introduction

The 5110 STS can be considered as three separate instruments with three levels of testing of a semiconductor.

Level One is a GOOD/BAD indication using the GO/NO-GO switch in positions one through six (position 10 for diodes).

Level Two is a fault analysis of open-short conditions using the GONO-GO switch in positions 7, 8, 9 (position 10 for diodes).

Level Three is for parameter measurements such as V_{BE}, I_{CBO} or Beta using the parameter section of the 5110.

Level One tests can be performed in or out of circuit, and identify device polarity (NPN or PNP) and lead configuration as well as a GOOD/BAD indication.

Level Two tests must be conducted with the device connected in the proper lead configuration.

Level Three tests are out-of-circuit tests only, and the device must be connected with the proper lead configuration and device polarity

LEVEL 1 TESTING — GO/NO-GO

Introduction

The following operational steps are provided for Basic GO/NO GO testing of transistors, FET's, Diodes and SCR's. When testing always start with the Indicator switch in Position 1 with the Drive switch in LO. Turn Indicator switch in the CW motion to Positon 6 slowly — if you don't get a NPN or PNP light, switch the Rocker switch to HI, set BASE Drive to HI, and move the Identification switch CCW from 6-1. If you fail to get an NPN or PNP light then you can assume the device is defective.

A. Transistors (Power and Signal Transistors)

1. Set Power rocker switch to — ON
   Set a Drive rocker switch to — LO
   Set Identification switch to — POSITION 1
   Set Audio Knob — as desired.
2. Insert the transistor-under-test in the appropriate test socket (TO-3, 5 or 66) or connect the mini-grabber test leads or 3-pin test probe to the device-under-test (DUT).

NOTE

If unsure of the DUT basing, leads can be connected to the DUT in any order, but test leads must be plugged into their respective colot test lead jack. (yellow-green-blue)

3. Move the Identification test switch slowly CW through its six positions until one of the two red LED's (NPN or PNP) glows. A tone will also be heard if the Audio has been turned on. Identification is determined by the lamp that is glowing (NPN/PNP). In the LO-position most transistors will only test GOOD in one Identification test switch position. When in this position the leads of the transistor will be identified in the LED display as:

   E — Emitter
   B — Base
   C — Collector

4. If you fail to obtain a GOOD indication as the Identification test switch is slowly moved CW through its six positions, in LO drive, then the D.U.T is one of the following:

   a) Transistor with high leakage or very low gain.

   b) Device with shorted/open elements.

   c) FET Device that will not test in LO drive.

   d) A device requiring a high base drive voltage such as a Darlington Power transistor.

e) An in-circuit device with excessive circuit shunting.

5. Set the Drive Current rocker switch to HI and the BASE DRIVE pot to MAX. Rotate the Identification switch CCW from Position 6 towards Position 1, checking for a "GOOD" (NPN or PNP) indicator to light.

NOTE

In the HI DRIVE, MAX BASE DRIVE mode, a good transistor with a high reverse beta will show "GOOD" in two adjacent switch positions with the E-C leads reversed (example EBC = CBE). The device is still correctly identified as GOOD or BAD, and NPN or PNP.

To identify the E-C leads, switch back and forth between the two positions while reducing BASE DRIVE until the NPN or PNP light will light in only one position.

B. FET's (Power or Signal FET's)

1. Set Power rocker switch to — ON
   Set Drive rocker switch to — HI
   Set Base Drive to — MAX
   Set Identification switch to — POSITION 1
   Set Audio Knob — to desired position
2. Insert device into appropriate socket (TO-3, 5 or 66) or connect the three test leads (in any order) to the FET.

NOTE

The three test leads must be plugged into their respective color test lead jack (Yellow-Green-Blue).

3. Move Identification test switch slowly CW from Position 1 until a GOOD FET LED is illuminated and a tone is heard.
4. The base (B) indicator shown in the display is the GATE. S-D leads are not identified.

NOTE

J-FET's will indicate GOOD in two adjacent test positions which have the same Base position. (Most J-FET's are symetrical).

5. If you fail to obtain a GOOD indication, the FET-under-test is defective.

C. Diodes

1. Set Power rocker switch to — ON
   Set Drive rocker switch to — LO
   Set Identification switch to — POSITION 10
   Set Audio Knob — to desired level.
2. For cathode lead identification connect diode to the Blue and Yellow test leads. If the diode is GOOD the Cathode will be identified with a "C". If the diode is a BAD diode, the "Open" or "Short" LED will illuminate. If the diode is GOOD a tone will be heard.

D. Zener Diodes

(Same as Diodes).

E. SCR's

1. Set Power Switch to — ON
   Set Drive Switch to — HI
   Set Identification Switch to — POSITION
2. Connect the three test leads (in any manner) to the three leads of the SCR under test.
3. Move the Identification test switch CW through the six positions.

NOTE

With most SCR's, the NPN LED will illuminate in one test position and the PNP will illuminate in another test position. Some medium and high voltage SCR's may provide only an NPN indication.

4. The SCR is GOOD if an NPN indication is obtained (the additional PNP indication, if obtained, only confirms the device is an SCR.)
5. With the Identification test switch in the position that provides the NPN indication, the lead identification will provide

   B — is the gate lead
   E — is the cathode lead
   C — is the anode lead.

6. If the NPN fails to light in any of the six positions the SCR is defective. A "GOOD" indication verifies that the SCR can be triggered into conduction.

LEVEL 2 TESTING — FAULT MODE

A. Transistors

The fault mode test is for testing transistors with known lead arrangements. Plug-in transistor into the test socket or use test leads in the EBC arrangement i.e.,

Yellow Lead — Emitter (1)
Green Lead — Base (2)
Blue lead — Collector (3)
} TO-5

Fault Switch Position 7 tests E-B Short/open
8 tests C-B Short/open
9 tests E-C Short

If there is a fault then short or open light will illuminate. During tests the following indicators will be illuminate.

Fault Switch Position 7 "E" "B"
8 "B" "C"
9 "E" "C'

NOTE

*In the Fault Mode, in order to test a transistor the lead arrangement **MUST** be known and transistor properly installed in order for the testing to proceed.*

B. Diodes

1. Set Power rocker switch to — ON
   Set Drive rocker switch to — LO
   Set Identification switch to — POSITION 10
   Set Audio Knob — as desired.
2. For cathode lead identification connect diode to the Blue and Yellow test leads. If the diode is GOOD the Cathode will be identified with a "C". If the diode is a BAD diode, the "Open" or "Short" LED will illuminate. If the diode is GOOD a tone will be heard.

LEVEL 3 TESTING — PARAMETER

The heart of the parameter section is the Parameter Test Switch, a ten position rotary switch used to select the test parameter and the Multifunction Parameter display which provides the appropriate readouts.

NOTE

When testing semiconduction devices in the Parameter section, lead configuration MUST be known and leads properly installed in appropriate test sockets. (i.e., B is base, E is emitter, and C is collector.)

Also, the type of device, NPN or PNP must be known and the proper pushbutton selected.

If in doubt about either of these functions, use the GO/NO-GO section to determine proper lead configuration and device type.

A. Parameter Testing

a) TRANSISTORS (Power and Signal)

1. Set Power Rocker Switch to.....ON
2. Set Parameter Switch to .....V_{BE}
3. Set NPN or PNP Switch as required.
4. Allow test set to warmup for 2 minutes before using.

b) SWITCH POSITION 1

Install DUT in proper socket (TO-5, TO-3, TO-66) taking extreme care to properly arrange leads.

OBSERVE
The display shall read the following:

Si or Ge — silicon or germanium depending on the device.
.XXX — a three digit display of the value of V_{BE}
V — indicating the reading is in volts

So, we know that the device has a V_{BE} of a certain value, that is either a silicon or germanium device and that it is a NPN or a PNP.

c) Rotate Parameter Switch one position. The switch is now in the LO BETA mode (I_b 5 10μA).

OBSERVE
The display will show only a three digit display—this is a ratio of the collector current to the base current or BETA.

The next two switch positions are also for Beta.

Position 3	MED BETA	1_b = 100 μA
Position 4	HI BETA	1_b = 10mA

NOTE

Care should be used in selecting the Beta range to test the transistor. It is possible to damage small signal transistors in the HI range. However, testing of power transistors in the LO range, although it will not damage the device, will result in a reading of little value as power transistors are not designed to operate at low current levels.

d) Position 5, g_m Reading (for FET's)

Set the NPN/PNP Switch to the proper type of device N-ch or P-ch, install the FET in the appropriate test socket with the lead configuration as follows:

FET	TRANSISTOR
Drain	Collector
Gate	Base
Source	Emitter

The display will show a reading of g_m and the m℧ lights will indicate the reading is in mill-mhos.

NOTE

Most plastic FET's have the GATE lead on the right side when facing the flat side with the leads down and the SOURCE in the middle, although there are exceptions.

In most Junction FET's, the source and drain can be interchanged without adverse effects.

e) Rotate parameter switch to Position 6 (I_{CBO}). Positions 6 through 10 provide a range from 2 μA through 10 mA as required.

Set NPN/PNP Switch to proper type of device. Install device inproper test socket observing correct lead configuration.

The display will read a three-digit readout and indicate μA or mA depending on the parameter selected.

The I_{CBO}/V_{CB} Readout rocker switch will vary the readout display from leakage current to voltage applied.

With the I_{CBO}/V_{CB} switch in the V_{CB} mode you can adjust the voltage applied with the variable voltage knob from 5 to 50 volts, switch to I_{CBO} and read the leakage current at the selected voltage level. Or, select the I_{CBO} and switch to V_{CB} to observe the voltage level at which it occurs.

General

The Model 5110 Semiconductor Test Set uses a high-current, low duty cycle pulse technique to test transistors. A six-position switch is used to enable the user to identify the leads of the D.U.T. in most in-circuit tests and all out-of-circuit tests. Circuitry is provided for out-of-circuit measurement of transistor beta and FET g_m, plus the testing of high current devices at rated current (up to 2 amperes) without over-dissipation and leakage.

At last there is a simple, sure and inexpensive way to detect defective components in-circuit or out-of-circuit, without the need of circuit power.

Selecting Drive Current

The STS provides two ranges of operation in the GO/NO-GO Section to facilitate a greater range of testing.

a) LO RANGE — In the LO range the drive currents are as follows:

base drive 1mA
collector 50mA

most testing will be accomplished in this range.

b) HI RANGE — In the HI range the drive currents are as follows:

base drive . . . . . 10mA to 100mA
collector 200mA

Fault Mode

The STS will allow fault isolation of a device in almost all cases when used properly. There are three fault positions. The first position provides for testing of emitter-base open/short. The second position provides testing of base collector junction, the third position is for emitter-collector junction short test. The fourth position is for testing open or short condition or diodes, if good the first or third LED indicator will light showing the location of the cathode of the diode under test.

The STS can be used to test virtually any component out-of-circuit, but where its real value shows is its ability to test devices in-circuit, transistors, FET's, diodes and other devices can be evaluated while installed on the printed circuit board, reducing the time required to locate defective parts while eliminating circuit board damage caused by removal and replacement of devices.

CAUTION

ALL TESTING OF IN-CIRCUIT COMPONENTS MUST BE PERFORMED WITH NO CIRCUIT POWER APPLIED. DO NOT ATTEMPT TO USE THE STS IN A LIVE CIRCUIT.

Application Notes

The following pages of application notes provide general information on various devices. These are provided for your help in determining what type of device and the lead determination.

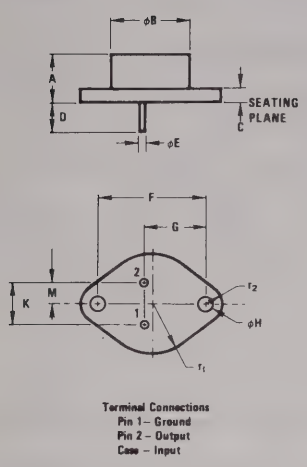
WARNING

Never apply power to device or P.C. Board being tested while connected to the Model 5110 Semiconductor Test Set.

All STS Testing of in-circuit components must be performed with NO CIRCUIT POWER applied and all capacitors discharged.

Package Outlines

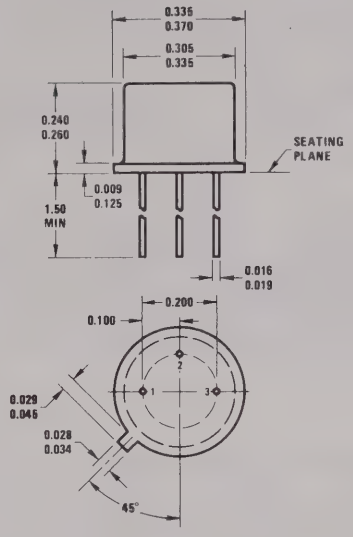
TO-3



Terminal Connections
Pin 1 – Ground
Pin 2 – Output
Case – Input

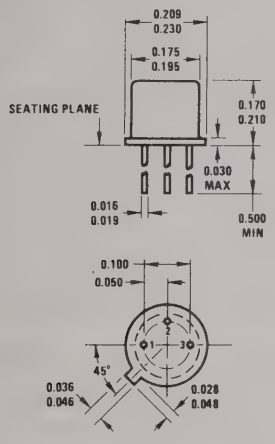
SYMBOL	INCHES	
	MIN	MAX
A	.250	.450
φE	.038	.043
φB		.875
K	.420	.440
M	.205	.225
C		.135
D	.312	
φH	.151	.161
F	1.177	1.197
r_1		.525
r_2		.188
G	.655	.675

TO-5



PIN	T
1	E
2	B
3	C

TO-18

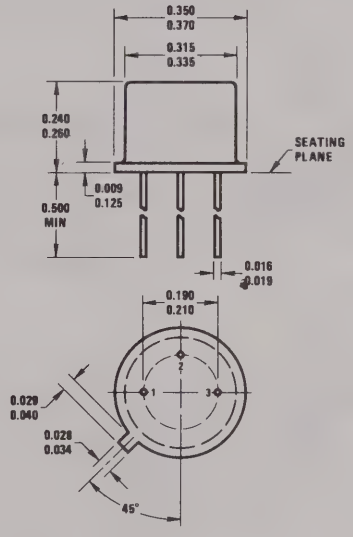


PIN	T
1	E
2	B
3	C

PIN	FET N
1	S
2	D
3	G

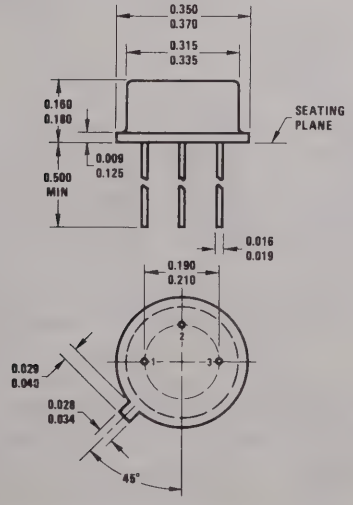
PIN	FET P
1	S
2	G
3	D

TO-39



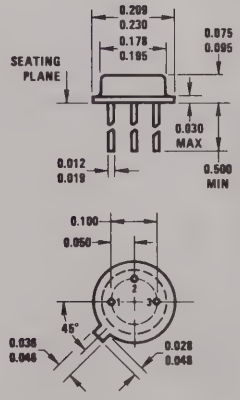
PIN	T
1	E
2	B
3	C

TO-39 LO-PROFILE



PIN	T
1	E
2	B
3	C

TO-46

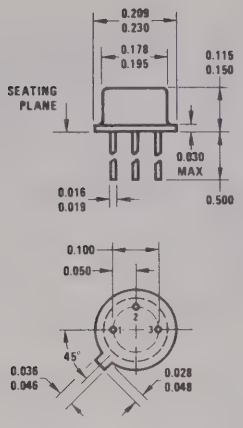


PIN	T
1	E
2	B
3	C

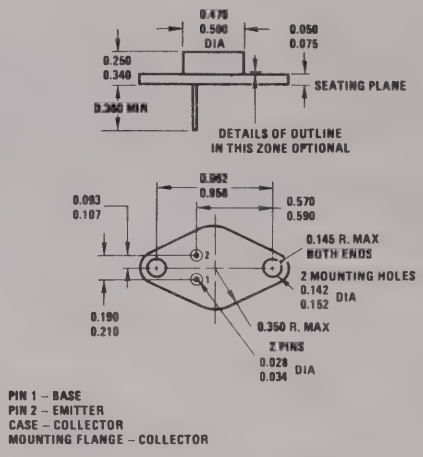
APPLICATIONS

TO-52

PIN	T	FET
1	E	S
2	B	D
3	C	G



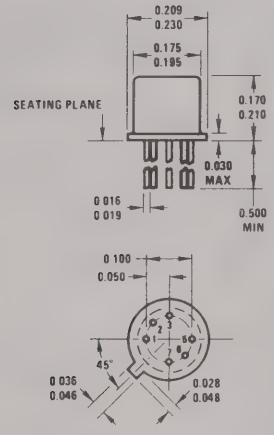
TO-66



PIN 1 – BASE
PIN 2 – EMITTER
CASE – COLLECTOR
MOUNTING FLANGE – COLLECTOR

TO-71

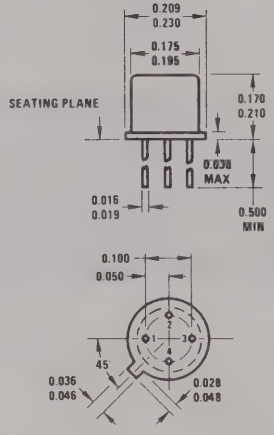
PIN	T	FET
1	E	S1
2	B	D1
3	C	G1
5	E	S2
6	B	D2
7	C	G2



TO-72

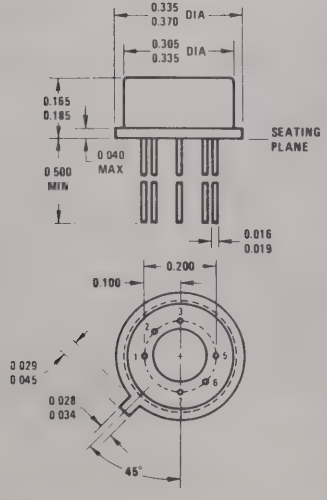
PIN	T	FET N
1	E	S
2	B	D
3	C	G
4	GND	CASE

PIN	T	FET P
1	B	S
2	E	G
3	C	D
4	GND	CASE



TO-78

PIN	T	FET
1	C	S1
2	B	D1
3	E	G1
5	E	S2
6	B	D2
7	C	G2

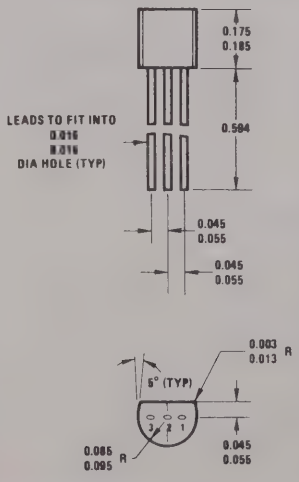


TO-92

PIN	(Std)	
	T	FET
1	C	G
2	B	S
3	E	D

PIN		
	T	FET
1	C	G
2	E	D
3	B	S

PIN		
	T	FET
1	B	S
2	C	G
3	E	D



Tips for Using the Model 5110

1. GERMANIUM TRANSISTORS — Nearly all germanium transistors come in metal cases, either in the tubular type with flexible leads or in the standard TO-5 package.
2. POWER TRANSISTORS — In TO-3 or TO-5 or stud packages can be either germanium, silicon or FET. Two or three digit 2N-numbers are mostly germanium.
3. The TO-66 power transistors and the plastic tab packages are nearly always silicon. The collector is usually, **but not always**, connected to the mounting tab and the center lead. Verification can be accomplished by a continuity check between the collector pin and the mounting tab.
4. The Base lead of most modern plastic-type transistors is either the center lead or the right-hand lead when facing the flat side with the leads down. In the latter case, the collector lead is the center lead.
5. FETS — most plastic FET's have the GATE lead on right side when facing the flat side with the leads down and the GATE lead on the right side when facing the flat side with the leads down and the SOURCE in the middle, but there are exceptions. In nearly all junction FET's, the source and drain can be interchanged without adverse effects.
6. POWER FETS — Power FET's in TO-3 packages generally have lead configurations similar to bipolar transistors, as follows:

FET	TRANSISTOR
DRAIN	COLLECTOR(CASE)
GATE	BASE
SOURCE	EMITTER

7. GERMANIUM SIGNAL DIODES — usually can be identified by their transparent hollow glass cases with either three or four color bands, or numbers printed on them.
8. SILICON DIODES — are usually painted because silicon is light sensitive and must be protected.
9. All transistors will have some gain with the collector and emitter leads interchanged, with the exception of Darlingtons.
10. There are certain semiconductor devices that look like transistors which the Model 5110 **cannot** test. These include: Triacs, diacs and diode arrays.

Glossary of Terms

$V_{BE(SAT)}$

Base-Emitter Saturation Voltage.
The base-emitter voltage measured in the common-emitter connection at a specified collector and base saturation currents.

Beta

The ratio of the collector current to the base current of a bipolar transistor, commonly referred to as either the common-emitter current gain or the current amplification factor.

I_{CBO}

Collector cutoff current.
The DC current into the collector terminal when it is biased in the reverse direction with respect to the base terminal and the emitter terminal is open-circuited.

V_{CB}

Voltage/Collector to Base.
Voltage, dc or average between the collector and the base. (Stated in terms of the polarity at the terminal indicated by the first subscript.)

g_m (m ℧)

Common-source forward transconductance (g_{fs}).

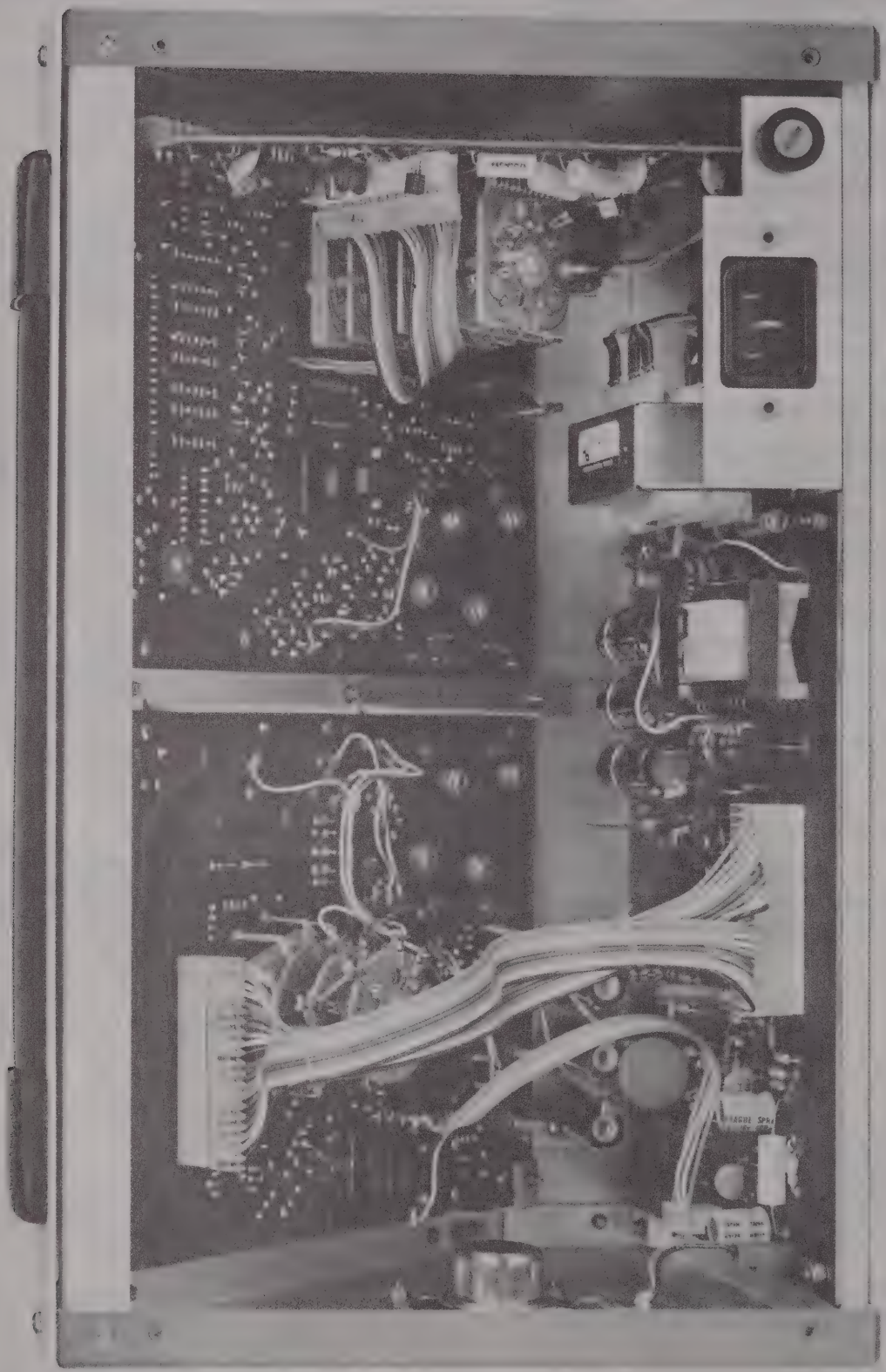


Figure 12. Rear View w/Cover Removed Showing Location of PC Boards

General

This chapter of the manual contains the information necessary for preventive maintenance, troubleshooting, corrective maintenance and calibration.

Preventive Maintenance

Preventive maintenance shall consist of periodic cleaning, inspecting, tightening, and recalibrating the instrument at a regular interval. This will keep the instrument at its operational and appearance peak.

CAUTION

Avoid the use of chemical cleaning agents such as MEK, laquer thinner, or strong acids or alkali. These solvents will cause paint removal, deterioration of switches and melting of plastic parts.

The accumlation of dirt or dust should be removed as noticed. The frequency of cleaning will depend on the environment in which the instrument is used. Loose dirt on the outside may be removed with a soft cloth or a dry brush. A diluted household cleaner (non-abrasive) may be used. Cleaning of the inside of the unit should be accomplished with LOW pressure air or a soft brush. Cleaning of the unit should precede the calibration, since the cleaning procedure could alter the settings.

CAUTION

***ALWAYS** remove the AC Power Cord from the connector on the rear panel before removing back and bottom covers. The interior of this instrument contains voltage levels which could be hazardous to your health. AC power lines are exposed when the covers are removed.*

Inspection

After cleaning the instrument, a thorough inspection of the components on the circuit boards can reveal areas where troubles could occur. Look for the obvious, like components with discolored markings from overheating. Check wiring for chafing. Removal of circuit boards is not recommended unless part replacement is required. Check that all screws are tight and all plugs and jacks are fully engaged.

Troubleshooting

Most of the problems resulting from a malfunction will be caused by the failure of an electronic component or a defective mechanical problem. Verify the obvious first. Check power, switch settings, etc., to verify proper inputs.

Standard test equipment can be used to isolate down to the component level. The use of the Functional Checkout Procedure on page 11, will verify the operation of the various controls.

Before starting troubleshooting a thorough knowledge of the operating procedure and the schematics will be of value.

Troubleshooting Precautions

WARNING

Before removing the covers for trouble shooting, read and observe the following precautions. Circuits are exposed which could become hazardous if not handled properly.

a) Always remove the power cord from the instrument BEFORE removing or replacing top and bottom covers.

b) When working on the instrument with the covers removed and the power cord connected, AC power is present at some points on the printed circuit board even with power "*OFF*".

c) Do not unplug any circuit boards or DIP connectors with power applied to the instrument.

Parts Identification

The Model 5110 is divided into three sub-assemblies as follows:

1. Power Supply Sub-Assembly (51105001)
2. Switch Board Sub-Assembly (51105002)
3. Panel Board Sub-Assembly (51105003)

These modules comprise the sub-assemblies that assemble into:

a) Chassis (51105005)

b) Final Assembly (51105006)

These assemblies and sub-assemblies are tabulated in Table 1.

Table 1. Model 5110 Assemblies

Table	Assembly Number	Assembly
2	51105001	Power Supply Board Sub-Assy
3	51105002	Switch Board Sub-Assy
4	51105003	Panel Board Sub-Assy
5	51105005	Chassis
6	51105006	Final Assembly

In addition there are three tables which contain parts lists of the varous sub-assemblies. Each part is identified by a drawing reference designator, manufacturer's part number, description of part, manufacturer, and Vu-Data part number.

Replacement Parts

Individual components are generally "*off-the-shelf*" and are available at local suppliers or may be ordered from Vu-Data Corporation. If other parts are substituted, verify that the part is a direct replacement, or performance and/or calibration difficulties may arise.

Calibration Procedure

The following procedure provides the information necessary for technical personnel to calibrate the Model 5110. This calibration should be performed at periodic intervals to certify proper operation.

Test Equipment Required

a) A Digital Multimeter.

b) A known good 2N3904 silicon transistor or equivalent.

CALIBRATION PROCEDURE

Preliminary Control Settings

Remove the AC power cord. Remove the rear/bottom cover. Plug in the AC line cord on the rear of the instrument and turn the instrument "*ON*", allow ten (10) minutes warm-up before starting calibration procedure.

Set the front panel controls as follows.

1. Power Sw.....ON
2. Identification/Fault Sw.....Pos. 1
3. Drive Current Sw.....LO
4. Parameter Test Sw.....V_{BE}
5. NPN/PNP Sw.....NPN

Verify that the following indicators are illuminated:

1. The EBC indicator is illuminated in the GO/NO-GO section.
2. The Si and V LED's are illuminated.
3. The DVM should read 1, showing an over-voltage condtion.

Power Supply Calibration

1. Verify —
   a) Parameter Sw set at V_{BE}
   b) Ident/Fault Sw at POS. 1
   c) Nothing is plugged into any of the test sockets
2. Turn instrument over face down on protective handles.
3. Locate R3 (+5V CAL) and R4 (−5V CAL) on the power supply board on the bottom side of the instrument (which is now facing you.) Locate large pad to left of resistor R4 — this is common.
4. Attach DMM to +5V at top center of board, adjust R3 for +5.000V ± 50mV.
5. Attach DMM to −5V at top center of board, adjust R4 for −5.000V ± 50mV.
6. Remove DMM — Set instrument in the upright position.

7. Plug the 2N93904 or equivalent silicon transistor into the PARAMETER TEST SOCKET. Verify NPN/PNP switch is in the NPN position.

   Readout should be approximately .750 with the Si and V LED's illuminted.

8. Connect the DMM LO lead to the emitter of the transistor. The HI lead to the base lead.

9. On the panel board adjust R28 (located top-center on the board) until the parameter readout on the STS equals the readout on the DMM.

This concludes the calibration procedure. Return all controls to normal/off configuration. Remove power line cord. Replace the rear/bottom cover. Reconnect power cord. Unit is now ready for use.

— CAUTION —

NEVER APPLY POWER TO DEVICE OR P.C. BOARD BEING TESTED WHILE CONNECTED TO THE MODEL 5110

ALL STS TESTING OF IN-CIRCUIT COMPONENTS MUST BE PERFORMED WITH NO CIRCUIT POWER APPLIED

Table 2. Parts List (Power Supply Board Sub-Assy 51105001)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
	51103001	Etched Circuit Board	Vu-Data	51103001
		CAPACITORS		
C1	TLB2A101M	100uf, 100V	Nichicon	6-87001
C2	ULBIE222M	Elect, 2200uf, 25V	Nichicon	6-87002
C3	ULBIE222M	Elect, 2200uf, 25V	Nichicon	6-87002
C4	CACO3Z5U104 Z050ALTR	Mono .1uf, 50V	Corning	6-36104
C5	CACO3Z5U104-ZO5OALTR	Mono .1uf, 50V	Corning	6-36104
C6	ULBIE222M	Elect, 2200uf, 25V	Nichicon	6-87002
C7	ULBIE222M	2200uf, 25V	Nichicon	6-87002
C8	CACO3Z5U104-ZO5OALTR	Mono .1uf, 50V	Corning	6-36104
C9	513D156M063AA4	Elect 15uf, 63V	Sprague	6-87156
C10	A11A105J	MYLAR, 1uf, 50V	Bishop	6-46105
C11	CACO3Z5U104-ZO5OALTR	Mono. .1uf, 50V	Corning	6-36104
C12	2DDH61J103XAJ	CD, .01uf, 150V	Centralab	6-27103
C13	503D107F016NB	Elect, 100uf, 16V	Sprague	6-87107
C14	CACO3Z5U104-ZO5OALTR	Mono .1uf, 50V	Corning	6-36104
C15	A11A273J	MM, .027uf, 50V	Bishop	6-46273
C16	CACO3Z5U104-ZO5OALTR	Mono .1uf, 50V	Corning	6-36104
C17	2DDH61J103XAJ	CD, .01uf, 150V	Centralab	6-27103
C18	503D107F016NB	Elect, 100uf, 16V	Sprague	6-87107
C19	CACO3Z5U104-ZO5OALTR	Mono .1uf, 50V	Corning	6-36104
C20	5HKD10	CD, .001uf,	Sprague	6-20102
C21	5HKD10	CD, .001uf,	Sprague	6-20102
C22	5HKD10	CD, .001uf,	Sprague	6-20102
C23	30GA-T39	DM, 390Pf,	Sprague	6-29391
C24	5GA-D50	CD, .001uf,	Sprague	6-29502
C25	5GA-D50	CD, .001uf,		6-29502
C26	H11A153J	MYLAR, .015uf, 50V	Bishop	6-46153
C27	2DDH61J103XAJ	CD, .01uf, 150V	Centralab	6-27103
C28	503D107F016NB	Elect, 100uf, 16V	Sprague	6-87107
C29	CACO3Z5U104-ZO5OALTR	.1uf, 50V	Corning	6-36104
C30	513D156M063AA4	Elect, 15uf, 63V	Sprague	6-87156
C31	DD-1032	CD, .01uf, 1KV	Centralab	6-29053
		CONNECTOR		
P1	2-640454-0	Header, 20 PIN	AMP	2-24060
P2	640454-5	Header, 5 PIN	AMP	2-24042
P3	1100-8-102-01	Header, 2 PIN	El. Sn. Comp.	2-24031

Table 2. Parts List (Power Supply Board Sub-Assy 51105001) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
		DIODES		
CR1	IN4004	Diode, Pwr	Motorola	3-14004
CR2	IN4004	Diode, Pwr	Motorola	3-14004
CR3	IN4004	Diode, Pwr	Motorola	3-14004
CR4	IN4004	Diode, Pwr	Motorola	3-14004
CR5	IN4004	Diode, Pwr	Motorola	3-14004
CR6	IN4004	Diode, Pwr	Motorola	3-14004
CR7	IN4004	Diode, Pwr	Motorola	3-14004
CR8	IN4004	Diode, Pwr	Motorola	3-14004
CR9	IN914	Diode, Signal	ITT	3-10914
CR10	IN914	Diode, Signal	ITT	3-10914
CR11	IN914	Diode, Signal	ITT	3-10914
CR12	IN914	Diode, Signal	ITT	3-10914
CR13	MR501	Diode, Pwr	Motorola	3-10501
CR14	MR501	Diode, Pwr	Motorola	3-10501
CR15	MR501	Diode, Pwr	Motorola	3-10501
CR16	MR501	Diode, Pwr	Motorola	3-10501
		INTEGRATED CIRCUITS		
U1	NE555	TIMER, 555	RCA	3-30555
U2	NE555	TIMER, 555	RCA	3-30555
U3	MC14011BCP	QUAD 2 INPUT NAND	Motorola	3-34011
U4	MC14013BCP	Dual D Flip-Flop	Motorola	3-34013
U5	UA339PC	Quad Comparator	Motorola	3-30339
U6	MC14013BCP	Dual D Flip-Flop	Motorola	3-34013
U7	MC14011BCP	Quad, 2 Input NAND	Motorola	3-34011
U8	MC14011BCP	Quad, 2 Input NAND	Motorola	3-34011
U9	NE555	Timer, 555	RCA	3-30555
U10	MC14023BCP	3-Input NAND	Motorola	3-34023
U11	MC14011BCP	Quad, 2 Input NAND	Motorola	3-34011
U12	LM317MP	Regulator	National	3-30317
U13	LM337MP	Regulator	National	3-30337
U14	T-200-4	Meter Regulator	Fredericks	3-32004
		RESISTORS		
R1	RN55D2490F	MF, 249 ohm, 1/8W, 1%	Allen Bradley	9-51101
R2	RN55D6340F	MF, 634 ohm, 1/8W, 1%	Allen Bradley	5-51173
R3	33865-1-201	VAR, 200 ohm, PC Mount	Bourns, Inc.	5-73201
R4	33865-1-201	VAR, 200 ohm, PC Mount	Bourns, Inc.	5-73201
R5	RN55D7320F	MF, 732 ohm, 1/8W, 1%	Allen Bradley	5-51173
R6	RN55D2490F	MF, 249 ohm, 1/8W, 1%	Allen Bradley	5-51134
R7	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R8	RCR07G470JR	CC, 47 ohm, 1/4W, 5%	Allen Bradley	5-10470
R9	RCR07G823JR	CC, 82K ohm, 1/4W, 5%	Allen Bradley	5-10823
R10	RCRO7G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R11	RCR07G823JR	CC, 82K ohm, 1/4W, 5%	Allen Bradley	5-10823
R12	RCR07G470JR	CC, 47 ohm, 1/4W, 5%	Allen Bradley	5-10470
R13	RCR07G474JR	CC, 470K ohm, 1/4W, 5%	Allen Bradley	5-10474
R14	RCR07G224JR	CC, 220K ohm, 1/4W, 5%	Allen Bradley	5-10224
R15	RCR07G223JR	22K ohm, 1/4W, 5%	Allen Bradley	5-10223
R16	RCR07G302JR	CC, 3K ohm, 1/4W, 5%	Allen Bradley	5-10302
R17	RCR07G302JR	CC, 3K ohm, 1/4W, 5%	Allen Bradley	5-10302

Table 2. Parts List (Power Supply Board Sub-Assy 51105001) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R18	RCR32G100JR	CC, 10 ohm, 1W, 5%	Allen Bradley	5-30100
R19	RCR07G473JR	CC, 47K ohm, 1/4W, 5%	Allen Bradley	5-10473
R20	RCR07G473JR	CC, 47K ohm, 1/4W, 5%	Allen Bradley	5-10473
R21	RCR20G511JR	CC, 510 ohm, 1/4W, 5%	Allen Bradley	5-20511
R22	RCR20G511JR	CC, 510 ohm, 1/4W, 5%	Allen Bradley	5-20511
R23		CC, 5.1 ohm, 1W, 5%	Allen Bradley	9-51137
R24	RCR07G473JR	CC, 47K ohm, 1/4W, 5%	Allen Bradley	5-10473
R25	RCR07G473JR	CC, 47K ohm, 1/4W, 5%	Allen Bradley	5-10473
R26	RCR07G473JR	CC, 47K ohm, 1/4W, 5%	Allen Bradley	5-10473
R27	RN55D1243F	MG, 124K ohm, 1/8W, 1%	Allen Bradley	5-51403
R28	RCR07G392JR	CC, 3.9K ohm, 1/4W, 5%	Allen Bradley	5-10392
R29	RCR07G395JR	CC, 3.9M ohm, 1/4W, 5%	Allen Bradley	5-10395
R30	RN55D90902F	MF, 90.9K ohm, 1/8W, 1%	Allen Bradley	5-51403
R31	RN55D90902F	MF, 90.0 K ohm, 1/8W, 1%	Allen Bradley	5-51403
R32	RCR07G473JR	CC, 47K ohm, 1/4W, 5%	Allen Bradley	5-10473
R33	RN55D1243F	MF, 124K ohm, 1/8W, 1%	Allen Bradley	5-51403
R34	RCR07G395JR	CC, 3.9M ohm, 1/4W, 5%	Allen Bradley	5-10395
R35	RCR07G392JR	CC, 3.9M ohm, 1/4W, 5%	Allen Bradley	5-10392
R36	RCR07G683JR	CC, 68K ohm, 1/4W, 5%	Allen Bradley	5-10683
R37	RCR07G472JR	CC, 4.7K ohm, 1/4W, 5%	Allen Bradley	5-10472
R38	RCR07G104JR	CC, 100K ohm, 114W, 5%	Allen Bradley	5-10104
R39	RCR07G392JR	CC, 3.9K ohm, 114W, 5%	Allen Bradley	5-10392
R40	RCR07G104JR	CC, 100K ohm, 114W, 5%	Allen Bradley	5-10104
R41	RCR07G473JR	CC, 47K ohm, 114W, 5%	Allen Bradley	5-10472
R42	RCR07G683JR	CC, 68K ohm, 114W, 5%	Allen Bradley	5-10683
R43	RCR07G395JR	CC, 3.9M ohm, 114W, 5%	Allen Bradley	5-10395
R44	RCR07G104JR	CC, 100K ohm, 114W, 5%	Allen Bradley	5-10104
R45	RCR07G683JR	CC, 68K ohm, 114W, 5%	Allen Bradley	5-10683
R46	RCR07G395JR	CC, 3.9M ohm, 114W, 5%	Allen Bradley	5-10395
R47	RCR07G392JR	CC, 3.9K ohm, 114W, 5%	Allen Bradley	5-10392
R48	RCR07G682JR	CC, 68K ohm, 114W, 5%	Allen Bradley	5-10682
R49	RCR07G104JR	CC, 100K ohm, 114W, 5%	Allen Bradley	5-10104
R50	RCR07G102JR	CC, 1K ohm, 114W, 5%	Allen Bradley	5-10102
R51	RCR07G823JR	CC, 82K ohm, 114W, 5%	Allen Bradley	5-10823
R52	RCR07G470JR	CC, 47 ohm, 114W, 5%	Allen Bradley	5-10470
R53	RCR07G470JR	CC, 47 ohm, 1/4W, 5%	Allen Bradley	5-10470
R54	RCR20G105JR	CC, 1M ohm, 1/2W, 5%	Allen Bradley	5-20105
55	RCR20G223JR	CC, 22 K ohm, 1/2W, 5%	Allen Bradley	5-20223
		TRANSISTORS		
Q1	2N3906	PNP	Fairchild	3-23906
Q2	2N3904	NPN	Fairchild	3-23904
Q3	2N3906	PNP	Fairchild	3-23906
Q4	2N3904	NPN	Fairchild	3-23904
Q5	2N3906	PNP	Fairchild	3-23906
Q6	2N3906	PNP	Fairchild	3-23906
Q7	2N2907A	PNP	National	3-22907
Q8	2N2222A	NPN	National	3-22222
		TRANSFORMER		
T1	ST2-48	PC Mount, 50V Supply	Signal	7-61037
M1	T-00-9	Elapsed Time Meter	Frederics	4-2050

Table 3. Parts List (Switch Board Sub-Assy 51105002)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
	51103002	ETCHED CIRCUIT BOARD		51103002
		CAPACITORS		
C1	CACO3Z5U104 ZO5OALTR	MONO, .1uf, 50V	Corning	6-36104
C2	ULBIE222M	ELECT, 2200uf, 25V	Nichicon	6-87002
C3	CACO3Z5U104 ZO5OALTR	MONO, .1uf, 50V	Corning	6-36104
C4	ULBIE222M	ELECT, 2200uf, 25V	Nichicon	6-87002
C5	2DDH611J103XAJ	CD, .01uf, 150V	Centralab	6-27103
C6	CM05GD101D03	DM, 100Pf, 500V	Corn'l Dubilier	6-19101
C7	CM05GD330D03	CM, 33Pf, 500V	Corn'l Dubilier	6-19330
C8	2DDH61J103XAJ	CD, .01uf, 150V	Centralab	6-27103
C9	CM05GD050D03	DM, 5Pf, 500V	Corn'l Dubilier	6-19050
C10	A11A105J	MM, 1uf, 50V	Bishop	6-46105
C11	A11A254J	MM, .25uf, 50V	Bishop	6-46254
C12	A11A105J	MM, .1uf, 50V	Bishop	6-46105
C13	2DDH61J103XAJ	CD, .01uf, 150V	Centralab	6-27103
C14	2DDH61J103XAJ	CD, .01uf, 150V	Centralab	6-27103
C15	2DDH61J103XAJ	CD, .01uf, 150V	Centralab	6-27103
C16	2DDH61J103XAJ	CD, .01uf, 150V	Centralab	6-27103
		CONNECTORS		
J3	3000-006-2103	PC CONN - 6 PIN	Methode	2-24061
J4	3000-006-2103	PC CONN - 6 PIN	Methode	2-24061
P2	1-640454-5	HEADER - 15 PIN		2-24030
		DIODES		
CR1	FD300	Small Signal Diode	Fairchild	3-10300
CR2	FD300	Small Signal Diode	Fairchild	3-10300
CR3	IN914	Small Signal Diode	ITT	3-10914
CR4	IN914	Small Signal Diode	ITT	3-10914
CR5	IN914	Small Signal Diode	ITT	3-10914
CR6	IN914	Small Signal Diode	ITT	3-10914
CR7	IN914	Small Signal Diode	ITT	3-10914
		INTEGRATED CIRCUITS		
U1	TI081ACP	FET OP-AMP	Texas Instrum.	3-0081
U2	TI081ACP	FET OP-AMP	Texas Instrum.	3-0081
U3	LM308AN	Low-Offset OP-AMP	National	3-30308
		RESISTORS		
R1	RCR07G433JR	CC, 43K ohm, 1/4W, 5%	Allen Bradley	5-10433
R2	RCR07G433JR	CC, 43K ohm, 1/4W, 5%	Allen Bradley	5-10433
R3	RN55D9092D	MF, 90.9K ohm, 1/8W, .5%	Allen Bradley	5-56390
R4	RN55D9091D	MF, 9.09K ohm, 1/8W, .5%	Allen Bradley	5-56295
R5	RN55D9090D	MF, 909 ohm, 1/8W, .5%	Allen Bradley	5-56189
R6	RN55D90R9D	MF, 90.0 ohm, 1/8W, .5%	Allen Bradley	5-56092
R7	RN55D10R2D	MF, 10.2 ohm, 1/8W, .5%	Allen Bradley	5-56001
R8	RCR07G433JR	CC, 4.3K ohm, 1/4W, 5%	Allen Bradley	5-10433
R9	RCR07G104JR	CC, 100K ohm, 1/4W, 5%	Allen Bradley	5-10104
R10	RN55D9092D	MF, 9.09K ohm, 1/8W, .5%	Allen Bradley	5-56295
R11	RCR07G430JR	CC, 430 ohm, 1/4W, 5%	Allen Bradley	5-10430

Table 3. Parts List (Switch Board Sub-Assy 51105002) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R12	RCR07G105JR	CC, 1M ohm, 1/4W, 5%	Allen Bradley	5-10105
R13	RN55D1020F	MF, 102 ohm, 1/8W, 1%	Allen Bradley	5-51097
R14	RN55D9090D	MF, 909 ohm, 1/8W, .5%	Allen Bradley	5-56189
R15	RN55D1000F	MF, 100 ohm, 1/8W, 1%	Allen Bradley	5-51096
R16	RN55D10R0F	MF, 10.0 ohm, 1/8W, 1%	Allen Bradley	5-50000
R17	RW69VIRO	WW, 1.00 ohm, 2.5W, 1%	Dale	5-60358
R18	RN55D1003F	MF, 100K ohm, 1/8W, 1%	Allen Bradley	5-51394
R19	RN55D1001F	MF, 1.00K ohm, 1/8W, 1%	Allen Bradley	5-51193
R20	RCR07G100JR	CC, 10 ohm, 1/4W, 5%	Allen Bradley	5-10100
R21	RN55D1000F	MF, 100 ohm, 1/8W, 1%	Allen Bradley	5-51096
R22	RN55D1002F	MF, 10,0K ohm, 1/8W, 1%	Allen Bradley	5-51299
R23	RN55D1002F	MF, 10.0K ohm, 1/8W, 1%	Allen Bradley	5-51299
R24	RCR07G822JR	CC, 8.2K ohm, 1/4W, 5%	Allen Bradley	5-10822
R25	RN55D1003F	MF, 100K ohm, 1/8W, 1%	Allen Bradley	5-51394
R26	RN55D4992F	MF, 49.9K ohm, 1/8W, 1%	Allen Bradley	5-51366
R27	RN55D1583F	MF, 158K ohm, 1/8W, 1%	Allen Bradley	5-51413
R28	RCR07G303JR	CC, 30K ohm, 1/4W, 5%	Allen Bradley	5-10303
R29	RCR07G10JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R30	RCR07G106JR	CC, 10M ohm, 1/4W, 5%	Allen Bradley	5-10106
R31	RN55D4993F	MF, 499K ohm, 1/8W, 1%	Allen Bradley	5-51461
R32	RN55D4992F	MF, 49.9K ohm, 1/8W, 1%	AllenBradley	5-51366
R33	RN55D4990F	MF, 499 ohm, 1/8W, 1%	Allen Bradley	5-51163
R34	RN55D4993F	MF, 499K ohm, 1/8W, 1%	Allen Bradley	5-51461
R35	RN55D4992F	MF, 49.9K ohm, 1/8W, 1%	Allen Bradley	5-51366
R36	RN55D4990F	MF, 499 ohm, 1/8W, 1%	Allen Bradley	5-51163
R37	RCR07G106JR	CC, 10M ohm, 1/4W, 5%	Allen Bradley	5-10106
R38	RN55D1021D	MF, 1.02K ohm, 1/8W, .5%	Allen Bradley	5-51194
		SWITCHES		
S1		7 DECK PC MOUNT	Standard Grigsby	51102017
S2		2-STATION P.B.	Centralab	51102018
		TRANSISTORS		
Q1	2N2907	PNP	National	3-22907
Q2	2N2222	NPN	National	3-22222
Q3	F2701	FET, N-CH	Solitron	3-22701
Q4	2N3904	PNP	Fairchild	3-23906
Q5	2N3904	PNP	Fairchild	3-23906
Q6	2N3906	NPN	Fairchild	3-23904
Q7	2N3904	NPN	Fairchild	3-23904
		HARDWARE		
	51102013	Knob, Push Button		51102013

Table 4. Parts List (Panel Board Assy 51105003)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
	51103003	PANEL BOARD		51103003
		CAPACITORS		
C1	A11A105J	MM, 1uf, 50V	Bishop	6-46105
C2	CAC03Z5U104Z050ALTR	MONO, .1uf, 50V	Corning	6-36104
C3	2DDH61J103XAJ	CD, .01uf, 150V	Centralab	6-27103
C4	503D107F016NB	ELECT, 100uf, 16V	Sprague	6-87107
C5	CAC03Z5U104Z050ALTR	MONO, .1ug, 50V	Corning	6-36104
C6	2DM15-681J	DM, 680Pf, 500V	Cornel Dublair	6-19681
C7	A32A223J	MM, .022uf	Bishop	6-46223
C8	2DDH61J103XAJ	CD, .01uf, 150V	Centralab	6-27103
C9	2DDH61J103XAJ	CD, .01uf, 150V	Centralab	6-27103
C10	513D156M063AA4	ELECT, 15uf	Sprague	6-87156
C11	A11A105J	MM, 1uf, 50V	Bishop	6-46105
C12	A11A224J	MM, .22uf, 50V	Bishop	6-46224
C13	A11A473J	MM, .047uf, 50V	Bishop	6-46473
C14	XA2A103J	MM, .01uf, 50V	IMB	6-46103
C15	A11A104J	MM, .1uf, 50V	Bishop	6-46104
C16	DM15-101J	DM, 100PF, 500V	Cornel Dublair	6-19101
C17	503D107F016NB	ELECT, 100uf, 16V	Sprague	6-87107
C18	CAC03Z5U104Z050ALTR	MONO, .1uf, 50V	Corning	6-36104
C19	A32A223J	MM, .022uf, 400V	Bishop	6-46223
C20	503D107F016NB	ELECT, 100uf, 16V	Sprague	6-87107
C21	CAC03Z5U104Z050ALTR	MONO, .1uf, 50V	Corning	6-36104
C22	CAC03Z5U104Z050ALTR	MONO, .1uf, 50V	Corning	6-36104
		COIL		
L1-L6	FB-43-101	Ferrite Bead	Amidon	5-90001
		CONNECTORS		
P1	2-640454-0	Header, 20 Pin	AMP	2-24055
P2	1-640-454-5	Header, 15 Pin	AMP	2-24030
P3	3100-1-206-01	Header, 6 Pin	Methode	2-24062
P4	3100-1-206-01	Header, 6 Pin	Methode	2-24062
J1	3760-4	Jack, Banana, Yellow	Pomona	2-24063
J7	3760-4	Jack, Banana, Yellow	Pomona	2-24063
J8	3760-5	Jack, Banana, Green	Pomona	2-24064
J13	3760-5	Jack, Banana, Green	Pomona	2-24064
J3	3760-6	Jack, Banana, Blue	Pomona	2-24065
J9	3760-6	Jack, Banana, Blue	Pomona	2-24065
J2	640441	Jack, 5-Pin	AMP	2-24043
		DIODES		
CR1	IN4576	Diode	Motorola	3-14576
CR2	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR3	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR4	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR5	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR6	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR7	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR8	IN914	Power, 1 Amp, 400V	ITT	3-10914

Table 4. Parts List (Panel Board Sub-Assy 51105003) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
CR9	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR10	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR11	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR12	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR13	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR14	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR15	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR16	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR17	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR18	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR19	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR20	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR21	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR22	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR23	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR24	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR25	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR26	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR27	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR28	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR29	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR30	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR31	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR32	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR33	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR34	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR35	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR36	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR37	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR38	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR39	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR40	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR41	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR42	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR43	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR44	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR45	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR46	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR47	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR48	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR49	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR50	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR51	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR52	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR53	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR54	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR55	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR56	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR57	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR58	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR59	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR60	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR61	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR62	IN914	Power, 1 Amp, 400V	ITT	3-10914

Table 4. Parts List (Panel Board Sub-Assy 51105003) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
CR63	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR64	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR65	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR66	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR67	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR68	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR69	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR70	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR71	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR72	IN914	Power, 1 Amp, 400V	ITT	3-10914
CR73	IN914	Power, 1 Amp, 400V	ITT	3-10914
		INTEGRATED CIRCUITS		
U1	ICL7107CPL	DMM/LED Driver	Intersil	3-37107
U2	CA555CE	Timer	RCA	3-30555
U3	MC14011BCP	QUAD 2-INPUT NAND	Motorola	3-34011
U4	UA339DC	QUAD COMPARITOR	Motorola	3-30339
U5	TL081ACP	FET INPUT OP AMP	Texas Instr.	3-30081
		LIGHTS		
DS1	5082-7750	7-Segment LED-RED	H.P.	3-17750
DS2	5082-7750	7-Segment LED-RED	H.P.	3-17750
DS3	5082-7750	7-Segment LED-RED	H.P.	3-17750
DS4	5082-7750	7-Segment LED-RED	H.P.	3-17750
DS5	HLMP-2300	LED LIGHT BAR-RED	H.P.	3-12300
DS6	HLMP-2300	LED LIGHT BAR-RED	H.P.	3-12300
DS7	HLMP-2300	LED LIGHT BAR-RED	H.P.	3-12300
DS8	HLMP-2300	LED LIGHT BAR-RED	H.P.	3-12300
DS9	HLMP-2300	LED LIGHT BAR-RED	H.P.	3-12300
DS10	HLMP-2300	LED LIGHT BAR-RED	H.P.	3-12300
DS11	5082-7750	7-Segment LED-RED	H.P.	3-17750
DS12	5082-7750	7-Segment LED-RED	H.P.	3-17750
DS13	5082-7750	7-Segment LED-RED	H.P.	3-17750
DS14	5331H1	RED LED w/base	Ind. Dev., Inc.	3-19102
DS15	5331H1	RED LED w/base	Ind. Dev., Inc.	3-19102
DS16	5331H1	RED LED w/base	Ind. Dev., Inc.	3-19102
CR17	5331H1	RED LED w/base	Ind. Dev., Inc.	3-19102
		RESISTORS		
R1	RCR07G103JR	CC, 10K ohm, 1/4W, 5%	Allen Bradley	5-10103
R2	RCR07G822JR	CC, 8.2K ohm, 1/4W, 5%	Allen Bradley	5-10811
R3	RCR07G680JR	CC, 680 ohm, 1/4W, 5%	Allen Bradley	5-10680
R4	RCR07G150JR	CC, 150 ohm, 1/4W, 5%	Allen Bradley	5-10150
R5	RCR07G150JR	CC, 150 ohm, 1/4W, 5%	Allen Bradley	5-10150
R6	RCR07G333JR	CC, 33K ohm, 1/4W, 5%	Allen Bradley	5-10333
R7	RCR07G334JR	CC, 330K ohm, 1/4W, 5%	Allen Bradley	5-10334
R8	RCR07G333JR	CC, 33K ohm, 1/4W, 5%	Allen Bradley	5-10333
R9	RCR07G562JR	CC, 5.6K ohm, 1/4W, 5%	Allen Bradley	5-10562
R10	RCR07G333JR	CC, 33K ohm, 1/4W, 5%	Allen Bradley	5-10333
R11	RN55D2102F	MF, 21.0K ohm, 1/8W, 1%	Allen Bradley	5-51330
R12	RCR07G470JR	EE, 47 ohm, 1/4W, 5%	Allen Bradley	5-10470
R13	RN55D4320F	MF, 432 ohm, 1/8W, 1%	Allen Bradley	5-51157
R14	RN55D1211F	MF, 1.21K ohm, 1/8W, 1%	Allen Bradley	5-51201
R15	RN55D3013F	MF, 301K ohm, 1/8W, 1%	Allen Bradley	5-51440

Table 4. Parts List (Panel Board Sub-Assy 51105003) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R16	RN5D1002F	MF, 10.0K ohm, 1/8W, 1%	Allen Bradley	5-51299
R17	RN55D1002F	MF, 10.0K ohm, 1/8W, 1%	Allen Bradley	5-51299
R18	RN55D49R9F	MF, 49.9 ohm, 1/8W, 1%	Allen Bradley	5-51067
R19	RCR07G474JR	CC, 470K ohm, 1/4W, 5%	Allen Bradley	5-10474
R20	RN55D8252F	MF, 82.5K ohm, 1/8W, 1%	Allen Bradley	5-51386
R21	RN55D3572F	MF, 35.7K ohm, 1/8W, 1%	Allen Bradley	5-51352
R22	RCR076106JR	CC, 10M ohm, 1/4W, 5%	Allen Bradley	5-10106
R23	RN55D4753F	MF, 475K ohm, 1/8W, 1%	Allen Bradley	5-51459
R24	RN55D4122F	MF, 41.2K ohm, 1/8W, 1%	Allen Bradley	5-51358
R25	RN55D6192F	MF, 61.9K ohm, 1/8W, 1%	Allen Bradley	5-51374
R26	RCR07G474JR	CC, 470K ohm, 1/4W, 5%	Allen Bradley	5-10474
R27	RN55D1501F	MF, 1.50K ohm. 1/8W, 1%	Allen Bradley	5-51210
R28	3386S-1-102	POT, 1K ohm	Bourns, Inc	5-73102
R29	RN55D2491F	MF, 2.49K ohm, 1/8W, 1%	Allen Bradley	5-51231
R30	RN55D1003F	MF, 100K ohm, 1/8W, 1%	Allen Bradley	5-51394
R31	RN55D4642F	MF, 4.64K ohm, 1/8W, 1%	Allen Bradley	5-51267
R32	RCR07G472JR	CC, 4.7K ohm, 1/4W, 5%	Allen Bradley	5-10472
R33	RCR07G472JR	CC, 4.7K ohm, 1/4W, 5%	Allen Bradley	5-10472
R34	RCR07G105JR	CC, 1M ohm, 1/4W, 5%	Allen Bradley	5-10105
R35	RN55D4642F	MF, 4.64K ohm, 1/8W, 1%	Allen Bradley	5-51267
R36	RCR07G105JR	CC, 1M ohm, 1/4W, 5%	Allen Bradley	5-10105
R37	RN55D3010F	MF, 301 ohm, 1/8W, 1%	Allen Bradley	5-51142
R38	RN55D3010F	MF, 301 ohm, 1/8W, 1%	Allen Bradley	5-51142
R39	RCR07G105JR	CC, 1M ohm, 1/4W, 5%	Allen Bradley	5-10105
R40	RCR07G105JR	CC, 1M ohm, 1/4W, 5%	Allen Bradley	5-10105
R41	RN55D1020F	MF, 102 ohm, 1/8W, 1%	Allen Bradley	5-51097
R42	RN55D1020F	MF, 102 ohm, 1/8W, 1%	Allen Bradley	5-51097
R43	RCR07G822JR	CC, 8.2K ohm, 1/4W, 5%	Allen Bradley	5-10822
R44	RCR07G470JR	CC, 470 ohm, 1/4W, 5%	Allen Bradley	5-10470
R 4 5	RCR07G822JR	CC, 8.2K ohm, 1/4W, 5%	Allen Bradley	5-10822
R46	RCR07G470JR	CC, 470 ohm, 1/4W, 5%	Allen Bradley	5-10470
R47	RCR07G510JR	CC, 510 ohm, 1/4W, 5%	Allen Bradley	5-10510
R48	RCR07G510JR	CC, 510 ohm, 1/4W, 5%	Allen Bradley	5-10510
R49	RCR07G103JR	CC, 10K ohm, 1/4W, 5%	Allen Bradley	5-10103
R50	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R51	RCR07G103JR	CC, 10K ohm, 1/4W, 5%	Allen Bradley	5-10103
R52	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R53	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R54	RCR07G510JR	CC, 510 ohm, 1/4W, 5%	Allen Bradley	5-10510
R55	RCR07G510JR	CC, 510 ohm, 1/4W, 5%	Allen Bradley	5-10510
R56	RCR07G433JR	CC, 43K ohm, 1/4W, 5%	Allen Bradley	5-10433
R57	RCR07G433JR	CC, 43K ohm, 1/4W, 5%	Allen Bradley	5-10433
R58	RN60D1004F	MF, 1M ohm, 1/4W, 1%	Allen Bradley	5-50490
R59	RCR42200JR	CC, 20 ohm, 2W, 5%	Allen Bradley	5-40200
R60	RCR42750JR	CC, 75 ohm, 2W, 5%	Allen Bradley	5-40750
R61	RCR42330JR	CC, 33 ohm, 2W, 5%	Allen Bradley	5-40330
R62	RCR42432JR	CC, 4.3K ohm, 2W, 5%	Allen Bradley	5-40432
R63	RCR07G680JR	CC, 680 ohm, 1/4W, 5%	Allen Bradley	5-10680
R64	RCR07G680JR	CC, 680 ohm, 1/4W, 5%	Allen Bradley	5-10680
R65	RCR07G433JR	CC, 43K ohm, 1/4W, 5%	Allen Bradley	5-10433
R66	RCR07G433JR	CC, 43K ohm, 1/4W, 5%	Allen Bradley	5-10433
R67	RCR07G222JR	CC, 2.2K ohm, 1/4W, 5%	Allen Bradley	5-10222
R68	RCR07G750JR	CC, 750 ohm, 1/4W, 5%	Allen Bradley	5-10750
R69	RCR07G750JR	CC, 750 ohm, 1/4W, 5%	Allen Bradley	5-10750

Table 4. Parts List (Panel Board Sub-Assy 51105003) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
R70	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-1-102
R71	RCR07G102JR	CC, 750 ohm, 1/4W, 5%	Allen Bradley	5-10750
R72	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R73	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R74	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R75	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R76	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R77	RCR07G104JR	CC, 100K ohm, 1/4W, 5%	Allen Bradley	5-10104
R78	RCR07G222JR	CC, 2.2K ohm, 1/4W, 5%	Allen Bradley	5-10222
R79	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R80	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R81	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R82	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R83	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen bradley	5-10102
R84	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R85	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R86	RCR07G222JR	CC, 2.2K ohm, 1/4W, 5%	Allen Bradley	5-10222
R87				
R88				
R89				
R90	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R91	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R92	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R93	RCR07G102JR	CC, 1K ohm, 1/4W, 5%	Allen Bradley	5-10102
R94	RCR07G104JR	CC, 100K ohm, 1/4W, 5%	Allen Bradley	5-10104
R95	RCR08G104JR	CC, 100K ohm, 1/4W, 5%	Allen Bradley	5-10104
R96	RCR07G222JR	CC, 2.2K ohm, 1/4W, 5%	Allen Bradley	5-10222
R97	RCR07G222JR	CC, 2.2K ohm, 1/4W, 5%	Allen Bradley	5-10222
R98	RCR07G223JR	CC, 22K ohm, 1/4W, 5%	Allen Bradley	5-10223
R99	RCR07G223JR	CC, 22K ohm, 1/4W, 5%	Allen Bradley	5-10233
R100	70AIN100P102U	MOD POT, 1K ohm	Allen Bradley	5-79531
R101	70CIN100P102/504U	DUAL MOD POT, 1K ohm	Allen Bradley	5-79532
R102		DUAL MOD POT, 500K ohm	Allen Bradley	
R103	70KIN100P102U	MOD POT, SWITCH-S4 1K ohm	Allen Bradley	5-79530
		TRANSISTORS		
Q1	2N5401	PNP,	Motorola	3-25401
Q2	2N5401	NPN,	Motorola	3-25401
Q3	2N5550	NPN,	Fairchild	3-25550
Q4	2N5550	NPN,	Fairchild	3-25550
Q5	2N3904	NPN,	Fairchild	3-23904
Q6	2N5550	NPN,	Fairchild	3-25550
Q7	2N5550	NPN,	Fairchild	3-25550
Q8	2N3906	PNP,	Fairchild	3-23906
Q9	2N3906	PNP,	Fairchild	3-23906
Q10	2N3904	NPN,	Fairchild	3-23904
Q11	2N3904	NPN,	Fairchild	3-23904
Q12	2N3904	NPN,	Fairchild	3-23904
Q13	2N3904	NPN,	Fairchild	3-23904
Q14	2N3906	PNP,	Fairchild	3-23906
Q15	2N3906	PNP,	Fairchild	3-23906
Q16	2N3904	NPN,	Fairchild	3-23904
Q17	2N3904	NPN,	Fairchild	3-23904
Q18	2N3904	NPN,	Fairchild	3-23904

Table 4. Parts List (Panel Board Sub-Assy 51105003) (Continued)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
Q19	2N3904	NPN,	Fairchild	3-23904
Q20	2N3904	NPN,	Fairchild	3-23904
Q21	2N3904	NPN,	Fairchild	3-23904
Q22	2N3904	NPN,	Fairchild	3-23904
Q23	2N3904	NPN,	Fairchild	3-23904
Q24	2N3904	NPN,	Fairchild	3-23904
Q25	F2701	N-CH FET	Solitron	3-22701
Q26	MPSA18	NPN,	Motorola	9-51155
Q27	MPSA18	NPN,	Motorola	9-51155
	22FT-632	#6 Locknut		8-90003
	79NM-40	#4 Locknut		8-90034
		4-40 9/16″ Pan HD, SS	Hays Blt	8-10076
	MS51957-33	6-32 7/8″ Pan HD		8-10033
	#9207	Alum, Stdoff, #6 CL, .187 × 1/4 Dia	H.S. Smith	4-20501
	#2670	Nylon Washer	H.H. Smith	8-60015
S1	7201-J1-V3-Q-E	Switch, PC Mount, Rocker	C.K.	2-10074
S2	5110 2019	Switch, 3 Deck, 10 Pos	Std. Grigsby	5110 2019
S3	7201-J1-V3-Q-E	Switch, PC Mount, Rocker	C.K.	2-10074
S4		Switch, Mod Pot		Part of R103
		SOCKETS		
	203-4050-00-1105	TO5	Textool	2-60021
	203-2492-00-1125	TO3	Textool	2-60022
	203-2702-00-1125	TO66	Textool	2-60023
	DIL-B14P108	14 PIN	Burndy	2-60013
	DIL-B40P108	40 PIN	Burndy	2-60017
	CDH-4000-16	16 PIN	Burndy	2-60009
	DIL-B8P108	8 PIN	Burndy	2-60024
		HARDWARE		
	MS51957-14	4-40 5/16″ Pan Head		8-10014
	51102010	Fuseholder Bracket	V-D	51102010
	MS35333-70	4-40 Int. Star Lk. Washer		8-40002
	031.1673	Fuse Holder		2-40021
	031.1666	Fuse Carrier 3AG		2-40022
	905-023	1/2″ Int. Lockwasher, Small O.D.	Littlefuse	8-90035
F1	313.250	Fuse 1/4A S.B.	Littlefuse	2-40004
F2	313.250	Fuse 1/4A S.B.	Littlefuse	2-40004
F3	313.250	Fuse 1/4A S.B.	Littlefuse	2-40004

Table 5. Parts List (Power Supply Assy 51105004)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
	51105001	Power Supply Board Sub-Assy		51105001
	51102008	Power Supply Bracket		51102008
T1	241-5-16	Transformer	Signal	7-61036
P1	EAC-301	Line Cord Socket	Switchcraft	2-24000
	AD44ABS	Pop Rivet	USM	4-20344
	MS15795-806	Backing Washer		8-50003
S1	7201J1ZQ	Power Switch DPDT	C.K.	2-10075
	031.1673	Fuse Holder	Pnl. Comp.	2-40021
	031.1666	Fuse Carryer Bag	Pnl. Comp.	2-40022
	1/2″ Int. Star	Fuse Lock Washer		8-90035
F1	313.250	Fuse 1/4 A S.B.	Littlefuse	2-40004
	79NM-40	#4 Nut-Locking		8-90034
	MS51957-3	#2-56 1/4 Pan Head		8-10003
	MS51957-43	#8-32 3/8 Pan Head		8-10043
	MS51957-14	#4-40 5/16 Pan Head		8-10014
	2630-N-12425-093	Nylon Shoulder Washer	Seastrom	8-60001
	7403-09FR-51	Sil Pad	Burquist	4-20290
	1410-4	#4 Ground Lug		4-20296

Table 6. Parts List (Chassis Assy 51105005)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
	51105004	Power Supply Assy		51105004
	51105003	Panel Board Assy		51105003
	51105002	Switch Board Assy		51105002
		15 Pin Cable Assy		None
	1-640441-5	Connector 15 Pin	Amp	2-24034
	112-2405-010	Ribbon Cable, 15 cond.	Spectrastrip	
		20 Pin Cable Assy		None
	2-640441-0	Connector 20 Pin	Amp	2-24056
	112-2405-010	Ribbon Cable, 20 cond.	Spectrastrip	
L1	25SP003	Speaker	Mouser	5-90103
J3	1300-102	2 Pin Jack	Methode	2-24033
	1400-113	Pin- Female	Methode	2-24038
	51102001	Side Panel — Left		51102001
	51102002	Side Panel — Right		51102002
	51102003	Rear Support		51102003
	51102004	Front Support		51102004
	51102005	Top Support		51102005
	51102006	Pan Bd Bracket — Left		51002006
	51102007	Pan Bd Bracket — Right		51102007
	51102009	Middle Support		51102009
	1410-4	#4 Ground Lug		4-20296
	MS51957-14	#4-40 × 5/16 Pan Hd		8-10014
	MS249693-3	#4-40 × 5/16 Flat Hd		8-30014
	NS24683-27	#6-32 × 6/16 Flat Hd		8-20029
	79NM-40	#4-40 Lock Nuts		8-90034

Table 7. Parts List (Final Assembly 51105006)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
	51105005	Chassis Assembly		51105005
	51102012	Rear Panel		51102012
	51102011	Front Panel		51102011
	51102015	Filter — Parameter		51102015
	51102014	Filter — Go/No-Go		51102014
	51102016	Serial Number Decal		51102016
	9352080	Calibration Tag		4-20312
	7861-315-314	Handle, Plastic	Phil. Hndl Co.	1-10852
	230-10AL8-32A	Handle, 4″, Black		4-10033
	F6B	#6 Foot	Budwig	4-20177
	PS-70BL-2 BLK	Knob, Large	Buckeye	4-10034
	PS-50D-2 BLK	Knob, Small	Buckeye	4-10035
	MS51957-14	4-40 × 5/16 Pan Head		8-10014
	79NM-40	4-40 Lock Nut		8-90034
	MS51957-28	6-32 × 3/8 Pan Head		8-10028
	MS24693-26	6-32 × 3/8 Flat Head		8-20028
	MS24693-46	8-32 × 1/4 Flat Head		8-20041

Table 8. Parts List (Miscellaneous 5110)

REFERENCE DESIGNATOR	MANUFACTURER PART NUMBER	DESCRIPTION	MANU-FACTURER	VU-DATA PART NO.
	Leader LP11-5′	Probe — 3 Prong with 3 Cond. Cable, 5′ Long	Leader	4-20414
	4-20415	Mini-Grabber Set		4-20415
	203-4050-00-1105	Socket — TO5	Textool	2-60021
	203-2492-00-1125	Socket — TO3	Textool	2-60022
	203-2702-00-1125	Socket — TO66	Textool	2-60023
	313.250	Fuse 1/4 A SB 3AG	Littlefuse	2-40004
	51102020	Pouch/Case		51102020
	4-20413	Manual		4-20413
	SPH-386	Line Cord	Belden	2-70005

This manual contains the following drawings:

Title	Drawing Number
Schematic Power Supply	51101001
Schematic Switch Board	51101002
Schematic Panel Board—Parameter	51101003, sh 1
Schematic Panel Board—Go/No-Go Section	51101003, sh 2
Wiring Diagram Model 5110	51101008
Power Supply Sub-Assy	51105001
Switch Board Assy	51105002
Panel Board Assy	51105003
Outline Drawing Model 5110	51105007

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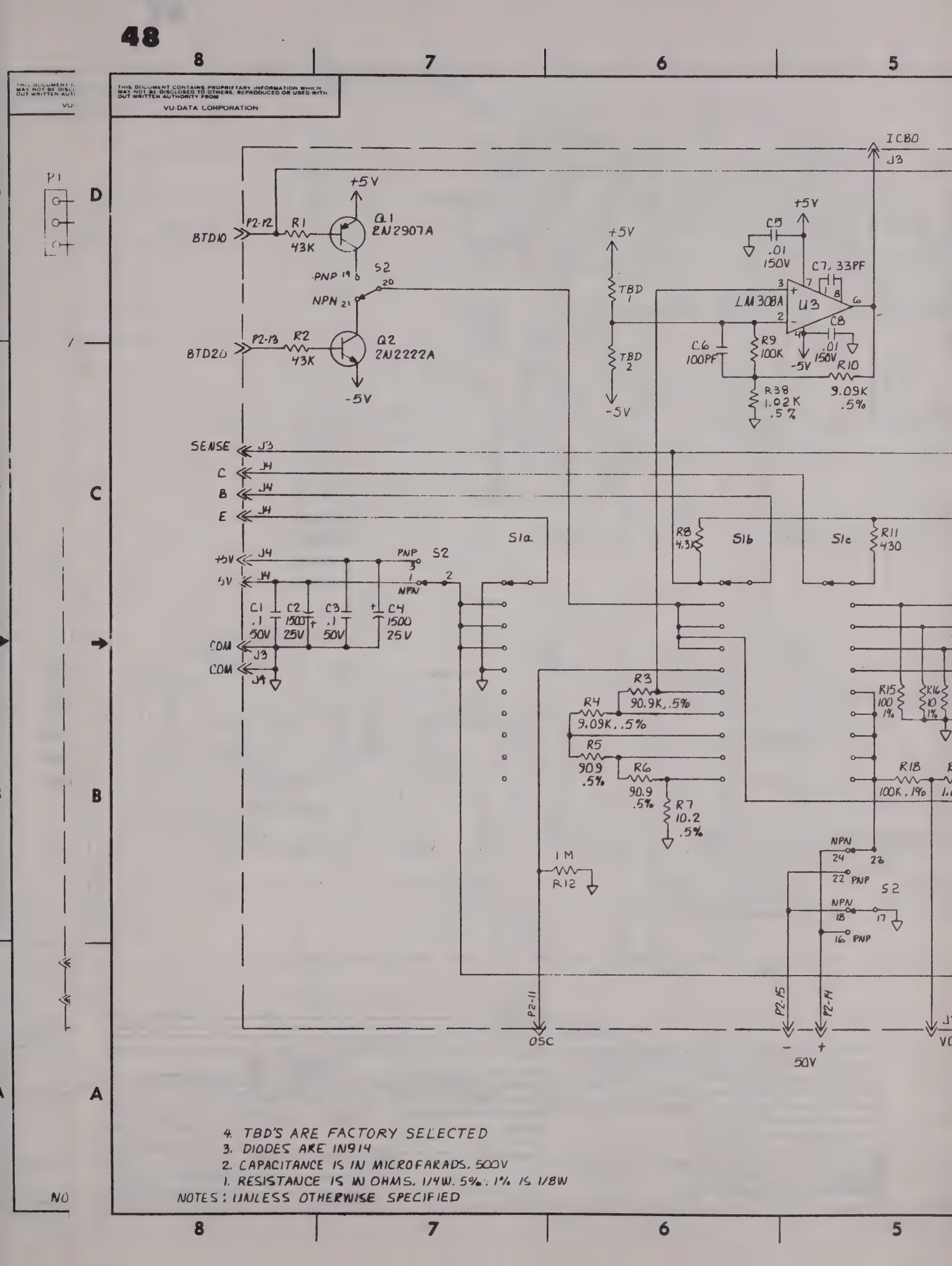

4. TBD'S ARE FACTORY SELECTED
3. DIODES ARE IN914
2. CAPACITANCE IS IN MICROFARADS. 500V
1. RESISTANCE IS IN OHMS. 1/4W. 5%. 1% IS 1/8W

NOTES: UNLESS OTHERWISE SPECIFIED

This manual contains the following drawings:

Title	Drawing Number
Schematic Power Supply	51101001
Schematic Switch Board	51101002
Schematic Panel Board—Parameter	51101003, sh 1
Schematic Panel Board—Go/No-Go Section	51101003, sh 2
Wiring Diagram Model 5110	51101008
Power Supply Sub-Assy	51105001
Switch Board Assy	51105002
Panel Board Assy	51105003
Outline Drawing Model 5110	51105007

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REVISIONS

REV	DESCRIPTION	DATE	APPROVED

P1 BLK GRN WHT — F1 — S1 POWER ON — T1 ST2-48 — K54 1M 1/2W — C31 .01, 1KV — U14 — M1

COMMON
CHASSIS
EARTH

+50V -50V — P1-2 — P1-1 +5V

CR1-CR4 IN4004 — CR1 CR2 CR3 CR4 — R55 22K ½W — C1 75 75V

CR5-CR8 IN4004 — CR5 CR6 CR7 CR8

U12 - LM317 — IN OUT ADJ — R1 249, 1% — R2 634, 1% — R3 200 — R4 200 — R5 634, 1% — R6 249, 1%

C2 C3 2200 25V (2) — C4 C5 .1 50V (2) — C6 2200 25V (2) — C7 C8 .1 50V — C9 15 50V

U13 - LM337 — ADJ IN OUT — +5V — -5V

U1 NE555 — R7 1K — R8 47 — R9 82K — C10 1 50V — C11 .1 50V — C12 .01 150V — C13 100 16V — C14 .1 50V — C15 .027 50V — C16 .1 50V — C17 .01 150V

U2 NE555 — R10 1K — R11 82K — R12 47 — C18 100 16V — C19 .1 50V

4011 U3 — 4013 U6 — 4011 U7 — BDR10 — ABD30

R16 3K — 3906 Q3 — CR 13 MR 501 — R19 47K — R18 10 1W — CR14 MR 501 — R20 47K — Q1 — Q2 — R17 3K — Q4 3904 — 3906

R21 510 — Q7 2907 — CR 15 MR 501 — R24 47K — R22 510 — R23 5.1 1W — Q5 3906 — Q8 2222A — CR 16 MR 501 — R25 47K — Q6 3906 — ACD40

4011 U3 — R13 470K — C20 .001 — C21 .001 — R15 22K — TDR10 — TDR20

R14 220K — C22 .001 — CDR10 — C23 390 PF

+5V — P1-15 P1-16 P1-17 P1-18 P1-3 P1-4 P1-19 P1-20 — -5V

+5V — P2-3 P2-4 P2-1 P2-5 P3-1 P3-2 — J2-3 J2-4 OFF S2 — J2-1 R103 1K CW — J3-1 J3-2 L1 8Ω

R50 1K — R52 47 — R51 82K — U19 NE555 — C30 15 50V — R53 47 — C28 100 16V — C29 .1 50V — C26 .015 50V — C27 .01 150V

+5V — R36 68K — R37 4.7K — R38 100K — R39 3.9K — U15 — R43 3.9M — C24 .005 — CR9 — CR 10 — CR 11 — CR 12 — R40 100K — R42 68K — R44 100K — R45 68K — R46 3.9M — R47 3.9K — C25 .005 — R41 4.7K — R48 68K — R49 100K — -5V

U5 - LM339
PIN 3 = +5V
PIN 12 = -5V

CDR20 — U10 4023 — U11 4011 — NPN LED — PNP LED — U10 4023

P1-8 GDI00 — P1-5 NPN — P1-6 PNP

+5V — R27 124K 1% — R28 3.9K — U5 — R29 — R26 47K — R30 90.9K, 1% 3.9M — R31 90.9K, 1% — R35 3.9K — R32 47K — R34 3.9M — R33 124K 1% — -5V

4013 U4 — 4011 U18 — P1-11 — P1-14 — SHORT P1-12 — OPEN P1-13 — ACD60 P1-10

NOTES: UNLESS OTHERWISE SPECIFIED

1. RESISTANCE IS IN OHMS. 1/4W, 5%. 1% IS 1/8W
2. CAPACITANCE IS IN MICROFARADS. 50OV
3. DIODES ARE IN914
4. U3, U4, U6, U7, U8, U10, & U11 SUPPLY PINS ARE:
   V_{DD} – PIN 14, & V_{SS} – PIN 7
5. L1 (SPEAKER) MOUNTED ON RIGHT SIDE PANEL
6. R103, S4, & J2 MOUNTS ON PANEL BOARD

ITEM NO	QTY REQD	DESCRIPTION	SCHEM DES	VU-DATA PN	MIL OR VENDOR PN	CODE OR SPEC NO.

LIST OF MATERIAL

PART NO	QTY REQD	NEXT ASSEMBLY	USED ON
APPLICATION			

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: FRACTIONS ± DECIMALS X ± .000, .XX ± .030, .XXX ± .010
ANGLES ± — SURFACE FINISH ✓ — MATERIAL — FINISH

CONTRACT NO. — DRAWN C. Stuart 84-2-1 — CHECKED — ENGINEER — APPROVED — APPROVED — APPROVED — CUSTOMER APPROVAL — RELEASE

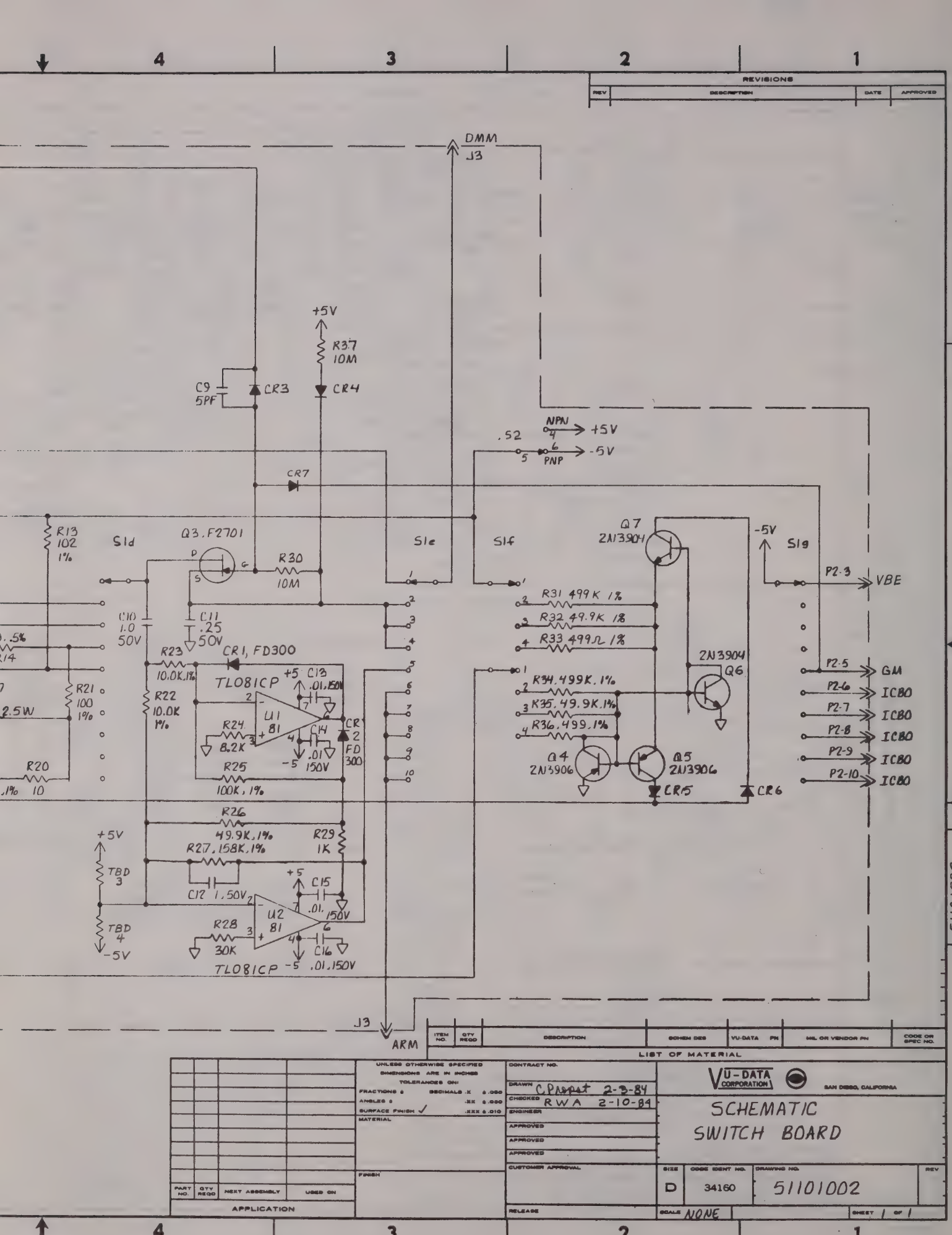
VU-DATA CORPORATION — SAN DIEGO, CALIFORNIA

SCHEMATIC POWER SUPPLY

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	34160	51101001	

SCALE NONE — SHEET 1 OF 1

51101001


REVISIONS
REV
DESCRIPTION
DATE
APPROVED
DMM
J3
+5V
R37
10M
C9
5PF
CR3
CR4
.52
NPN
PNP
+5V
-5V
CR7
R13
102
1%
S1d
Q3, F2701
R30
10M
S1e
S1f
Q7
2N3904
-5V
S1g
P2-3
VBE
R31 499K 1%
R32 49.9K 1%
R33 499Ω 1%
C10
1.0
50V
C11
.25
50V
R23
10.0K,1%
CR1, FD300
TL081CP
+5
C13
.01,150V
R22
10.0K
1%
U1
81
R24
8.2K
C14
.01
150V
-5
CR2
FD
300
R25
100K, 1%
2N3904
Q6
R34 499K, 1%
R35, 49.9K, 1%
R36, 499, 1%
P2-5
GM
P2-6
ICBO
P2-7
ICBO
P2-8
ICBO
P2-9
ICBO
P2-10
ICBO
R21
100
1%
2.5W
R20
10
Q4
2N3906
Q5
2N3906
CR5
CR6
R26
49.9K, 1%
R29
1K
R27, 158K, 1%
+5V
TBD
3
TBD
4
-5V
C12 1, 50V
+5
C15
.01, 150V
U2
81
R28
30K
C16
.01, 150V
TL081CP
J3
ARM
51101002
ITEM NO.
QTY REQD
DESCRIPTION
SCHEM DES
VU-DATA PN
MIL OR VENDOR PN
CODE OR SPEC NO.
LIST OF MATERIAL
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ±
DECIMALS .X ±.050
ANGLES ±
.XX ±.030
SURFACE FINISH ✓
.XXX ±.010
MATERIAL
FINISH
CONTRACT NO.
DRAWN C. Propst 2-3-84
CHECKED RWA 2-10-84
ENGINEER
APPROVED
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE
VU-DATA CORPORATION
SAN DIEGO, CALIFORNIA
SCHEMATIC
SWITCH BOARD
SIZE D
CODE IDENT NO. 34160
DRAWING NO. 51101002
REV
SCALE NONE
SHEET 1 OF 1
PART NO.
QTY REQD
NEXT ASSEMBLY
USED ON
APPLICATION

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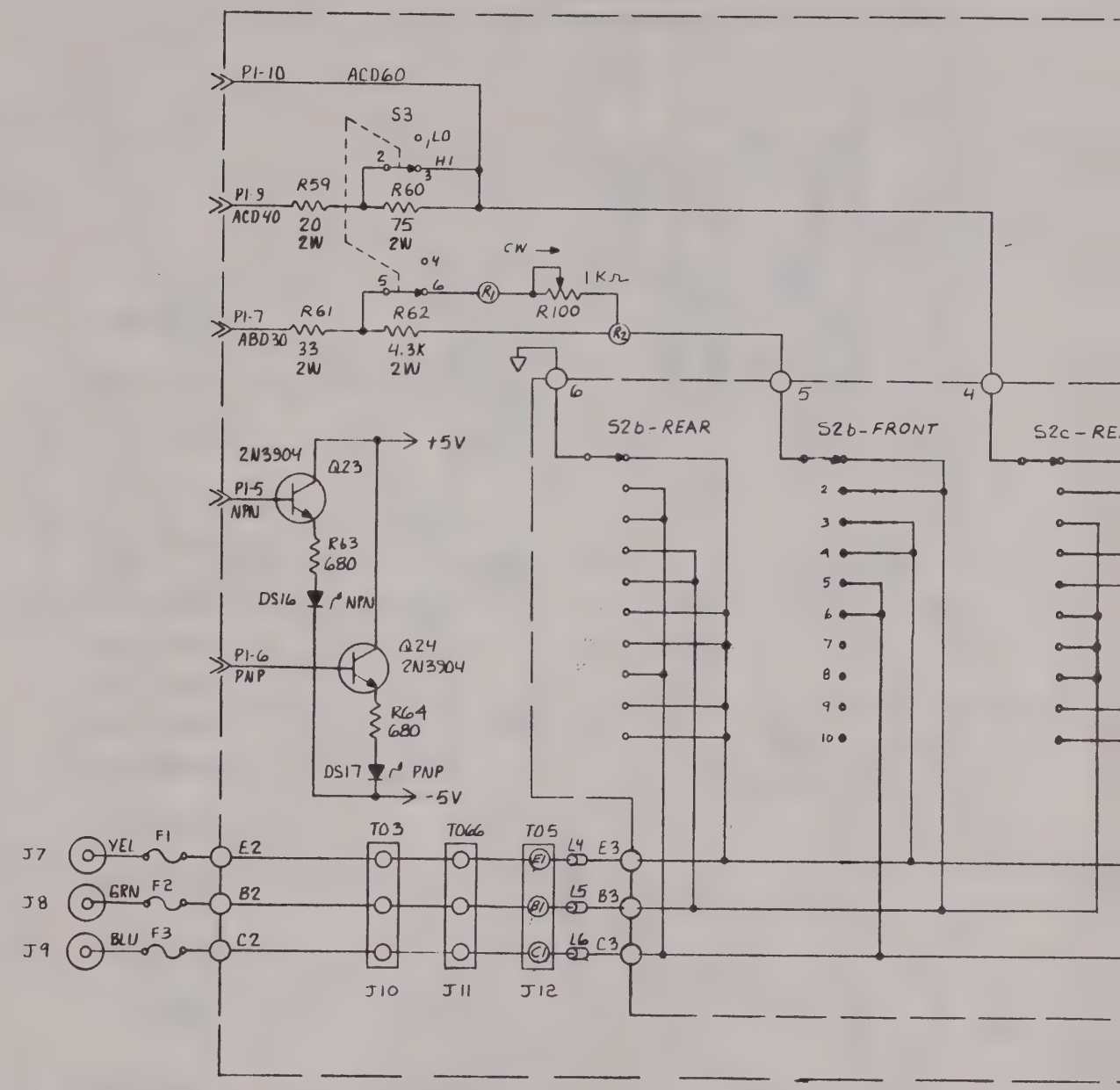

NOTES: UNLESS OTHERWISE SPECIFIED

1. RESISTORS R70-76, R79-85, & R87-93 ARE 1K 5%

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REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

ICBO J3 — DMM J3

BTD10 P2-12 R1 43K Q1 2N2907A +5V
BTD20 P2-13 R2 43K Q2 2N2222A -5V
S2: PNP 19, NPN 21, 20

+5V TBD 1 / TBD 2 -5V

C5 .01 150V; C7 33PF; C8 .01 150V; LM308A U3; C6 100PF; R9 100K; R10 9.09K .5%; R38 1.02K .5%

C9 5PF; CR3; CR4; R37 10M

SENSE J3; C J4; B J4; E J4

+5V J4; 5V J4; COM J3; COM J4

C1 .1 50V; C2 1500 25V; C3 .1 50V; C4 1500 25V

S1a S1b S1c S1d S1e S1f S1g

R8 4.3K; R11 430; R13 102 1%; R30 10M; R31 499K 1%; R32 49.9K 1%; R33 499Ω 1%; R34 499K 1%; R35 49.9K 1%; R36 499 1%

Q3 2N2907; Q7 2N3904; Q6 2N3904; Q4 2N3906; Q5 2N3906

S2 .S2: NPN +5V, PNP -5V

CR1 FD300; CR2 FD300; CR5; CR6; CR7

C10 1.0 50V; C11 .25 50V; C12 1,50V; C13 .01,150V; C14 .01 150V; C15 .01,150V; C16 .01,150V

R3 90.9K .5%; R4 9.09K .5%; R5 909 .5%; R6 90.9 .5%; R7 10.2 .5%; R12 1M

R14 909 .5%; R15 100 1%; R16 10 1%; R17 1 1% 2.5W; R18 100K 1%; R19 1.00K 1%; R20 10; R21 100 1%

R23 10.0K 1%; R22 10.0K 1%; R24 8.2K; R25 100K 1%; R26 49.9K 1%; R27 158K 1%; R28 30K; R29 1K

U1 81; U2 81; TL081CP

+5V TBD 3 / TBD 4 -5V

S2: NPN 24, 23, PNP 22; NPN 18, 17, PNP 16

P2-11 OSC; P2-15 / P2-14 50V; J3 VCB; J3 ARM

P2-3 VBE; P2-5 GM; P2-6 ICBO; P2-7 ICBO; P2-8 ICBO; P2-9 ICBO; P2-10 ICBO

4. TBD'S ARE FACTORY SELECTED
3. DIODES ARE IN914
2. CAPACITANCE IS IN MICROFARADS. 500V
1. RESISTANCE IS IN OHMS. 1/4W. 5%. 1% IS 1/8W

NOTES: UNLESS OTHERWISE SPECIFIED

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES	VU-DATA PN	MFR OR VENDOR PN	CODE OR SPEC NO.

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: FRACTIONS ± DECIMALS .X ± .000 .XX ± .000 ANGLES ± .XXX ± .010
SURFACE FINISH ✓
MATERIAL
FINISH

PART NO	QTY REQD	NEXT ASSEMBLY	USED ON

APPLICATION

CONTRACT NO.
DRAWN C.Pingat 2-3-84
CHECKED RWA 2-10-84
ENGINEER
APPROVED
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE

VU-DATA CORPORATION SAN DIEGO, CALIFORNIA

SCHEMATIC
SWITCH BOARD

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	34160	51101002	

SCALE NONE SHEET 1 OF 1

51101002

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REVISIONS

REV	DESCRIPTION	DATE	APPROVED

+50V REG

P2-14

+50V

P1-2

R1 10K

R2 8.2K

R3 680

Q3 Q4 2N5550 (2)

R4 150

CR2

R5 150

CR3

Q1 2N5401

Q2 2N5401

Q5 2N3904

R101 1K

R102 500K

CW

R6 33K

Q6 Q7 2N5550 (2)

CR1 1N4816

R8 33K

R9 5.6K

R10 33K

R1 330K

-50V

P2-15

50V

P1-1

50V

P1-15

+5V

P1-14

+5V

+5V

R11 21.0K 1%

R12 47

C22 0.1 50V

U2 NE555

R13 432 1%

C1 .1 50V

C2 .1 50V

C3 .01 150V

C4 100 16V

C5 .1 50V

C20 100 16V

C21 .1 50V

+5V

4011

U3

-5V

-5V

P1-17

P1-18

P4

-5V

-5V

J1 YEL

J13 GRN

BLU

JB

E1

B1

C1

TO3 TO66 TO5

J4 J5 J6

L1 L2 L3

P4 C B E

BTD20

BTD10

P2-13

P2-12

P2-11

C6 .1

R14 1.21K 1%

R15 680PF 301K 1%

C7 .022 400V

R16 10.0K 1%

+5V

C8 .01 50V

U5 TL081CP

C9 .01 150V

-5V

R17 10.0K 1%

C10 15 50V

R24 41.2K 1%

R18 499 1%

R19 470K

Q25 E2701

R22 10M

C11 1 50V

Q26 MPSA18 (2)

Q27

R20 82.5K 1%

R21 35.7K 1%

R23 475K 1%

R25 61.9K 1%

-5V

C19 .022 400V

R58 1M

P3

DMM

+5V

DS1

DS2

DS3

DS4

U1 ICL7107CPL

C12 .22 50V

C13 .047 50V

R26 470K

C16 100PF

R30 100K 1%

C17 100 16V

C18 .1 50V

R31 4.64K 1%

R34 1M

R32 4.7K

R33 4.7K

-5V

U4

R35 4.64K 1%

R36 1M

R37 301 1%

R38 301 1%

R39 1M

R40 1M

R41 102 1%

R42 102 1%

U4 UA339

R27 1.5K 1%

R28 1K

R29 2.49K 1%

+5V

R43 8.2K

R45 8.2K

DS5 DS6 DS7 DS8

R49 10K

R51 10K

R53 1K

R44 470

R46 470

R47 510

R48 510

R50 1K

R52 1K

Q10 Q11 Q12 Q13

CR4 CR5 CR6 CR7 CR8 CR9 CR10 CR11 CR12 CR13

2N3904 (4)

CR14 CR15 CR16

CR17 CR18

CR19 CR20 CR21 CR22 CR23

CR24 CR25

CR26 CR27 CR28

CR33 CR29 CR30

CR34

CR31 CR32

DS10 SL

DS9 GE

R54 510

R55 510

+5V

Q9 2N3906

+5V

Q8 2N3906

R56 43K

R57 43K

4011

U3

U3

$\overline{SI}$

$\overline{GE}$

S1

P3 ARM

P3 ICBO

P3 VCB

P2-3 VBE

P2-5 GM2

P2-6 ICBO 1

P2-7 ICBO 2

P2-8 ICBO 3

P2-9 ICBO 4

P2-10 ICBO 5

P1-3 COM

P1-4 COM

P1-19 COM

P1-20 COM

P3 COM

P9 COM

P3 SENSE

3. DIODES ARE IN914
2. CAPACITANCE IS IN MICROFARADS, 500V
1. RESISTANCE IS IN OHMS, 1/4W, 5%. 1% IS 1/8W.

NOTES: UNLESS OTHERWISE SPECIFIED

ITEM NO	QTY REQD	DESCRIPTION	SCHEM DES	VU-DATA PN	MIL OR VENDOR PN	CODE OR SPEC NO

LIST OF MATERIAL

PART NO	QTY REQD	NEXT ASSEMBLY	USED ON
APPLICATION			

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS X ± .060, XX ± .030, XXX ± .010
ANGLES ±
SURFACE FINISH ✓
MATERIAL
FINISH

CONTRACT NO.
DRAWN C Pippert 84-2-4
CHECKED
ENGINEER
APPROVED
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE

VU-DATA CORPORATION SAN DIEGO, CALIFORNIA

SCHEMATIC
PANEL BOARD. PARAMETER

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	34160	51101003	

SCALE NONE SHEET 1 OF 2

51101003

REVISIONS

REV	DESCRIPTION	DATE	APPROVED

P2-5 GM

P2-6 ICBO

P2-7 ICBO

P2-8 ICBO

P2-9 ICBO

P2-10 ICBO

2N3904 Q6

Q5 2N3906

CR5 CR6

P2-3 VBE

-5V SIG

ITEM NO	QTY REQD	DESCRIPTION	SCHEM DES	VU-DATA PN	MIL OR VENDOR PN	CODE OR SPEC NO

LIST OF MATERIAL

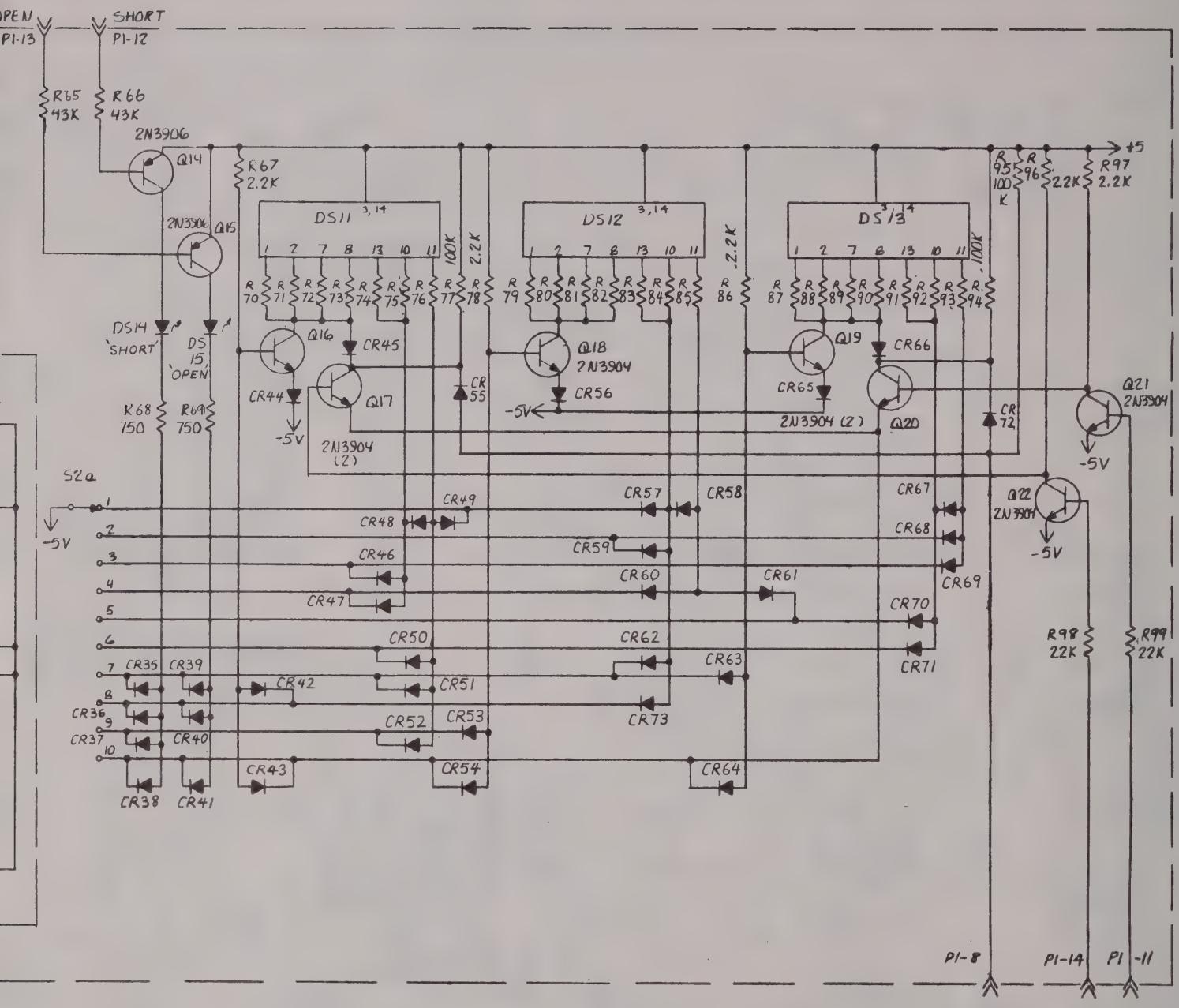
VU-DATA CORPORATION SAN DIEGO, CALIFORNIA

SCHEMATIC
SWITCH BOARD

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	34160	51101002	

SCALE NONE SHEET 1 OF 1

51101002



REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES	VU-DATA PN	MIL OR VENDOR PN	CODE OR SPEC NO

LIST OF MATERIAL

PART NO.	QTY REQD	NEXT ASSEMBLY	USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS .X ± .050
ANGLES ± .XX ± .030
SURFACE FINISH ✓ .XXX ± .010
MATERIAL
FINISH

CONTRACT NO.
DRAWN C. Propst 84-2-5
CHECKED
ENGINEER
APPROVED
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE

VU-DATA CORPORATION — SAN DIEGO, CALIFORNIA

SCHEMATIC PANEL BOARD. GO/NO-GO

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	34160	51101003	

SCALE NONE — SHEET 2 OF 2

51101003

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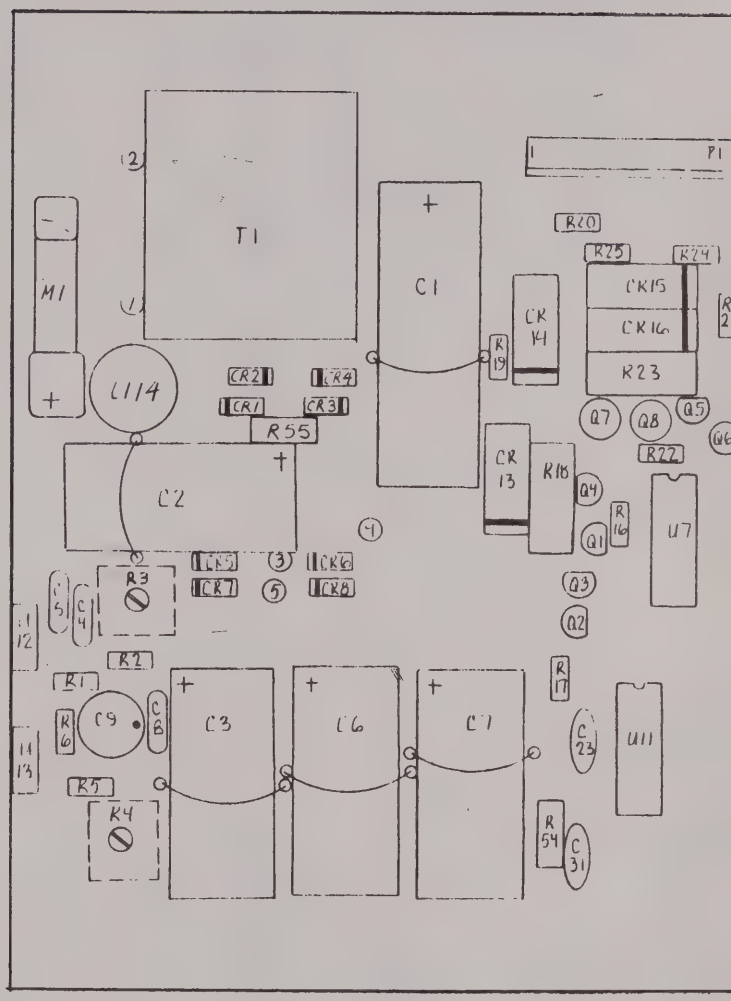

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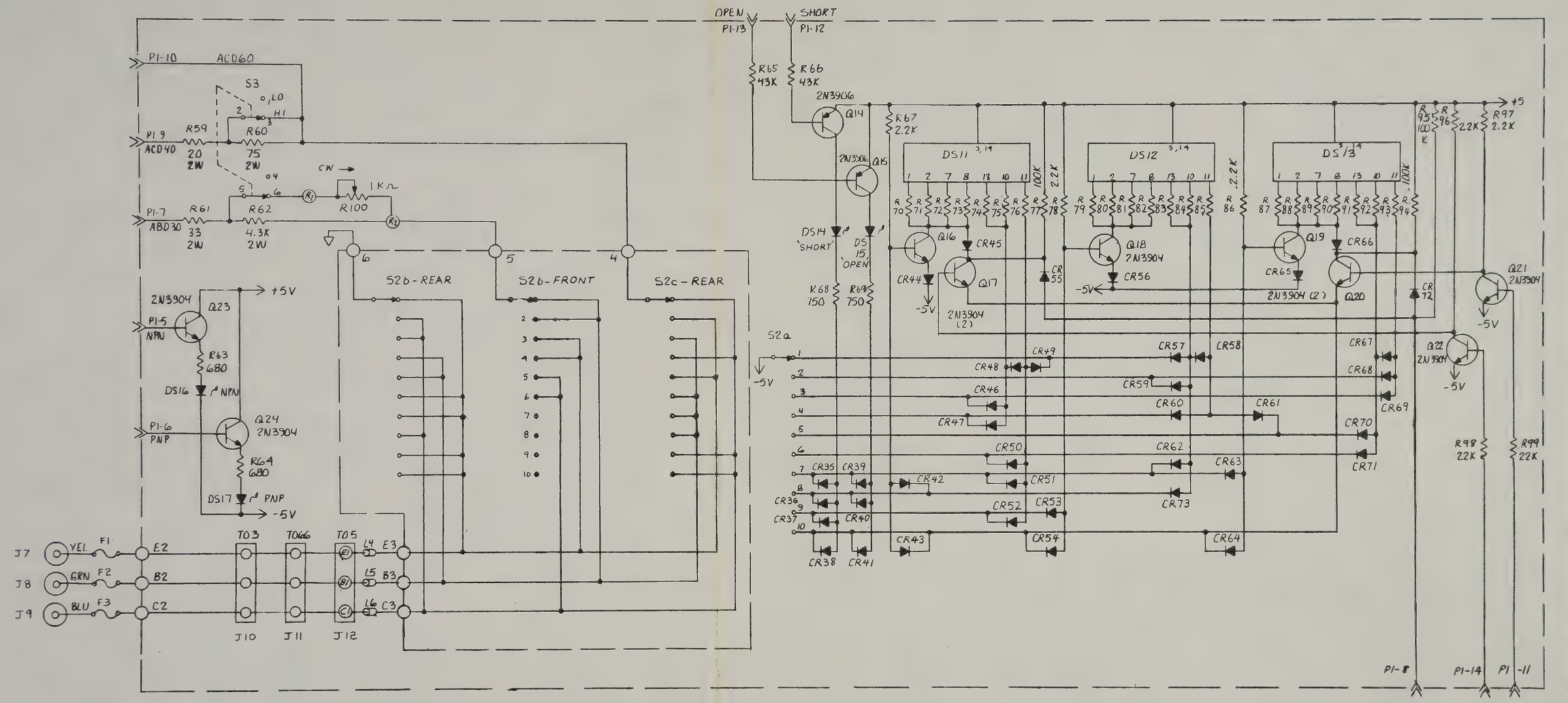
VU DATA CORPORATION

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



NOTES: UNLESS OTHERWISE SPECIFIED

1. RESISTORS R70-76, R79-85, & R87-93 ARE 1K 5%

ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES	VU DATA PN	MIL OR VENDOR PN	CODE OR SPEC NO

LIST OF MATERIAL

PART NO.	QTY REQD	NEXT ASSEMBLY	USED ON
APPLICATION			

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS .X ± .050
ANGLES ± .XX ± .030
SURFACE FINISH ✓ .XXX ± .010
MATERIAL
FINISH

CONTRACT NO.
DRAWN C. Proget 84-2-5
CHECKED M. Lee 5/7/85
ENGINEER
APPROVED
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE

VU-DATA CORPORATION SAN DIEGO, CALIFORNIA

SCHEMATIC
PANEL BOARD. GO/NO-GO

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	34160	51101003	

SCALE NONE SHEET 2 OF 2

51101003

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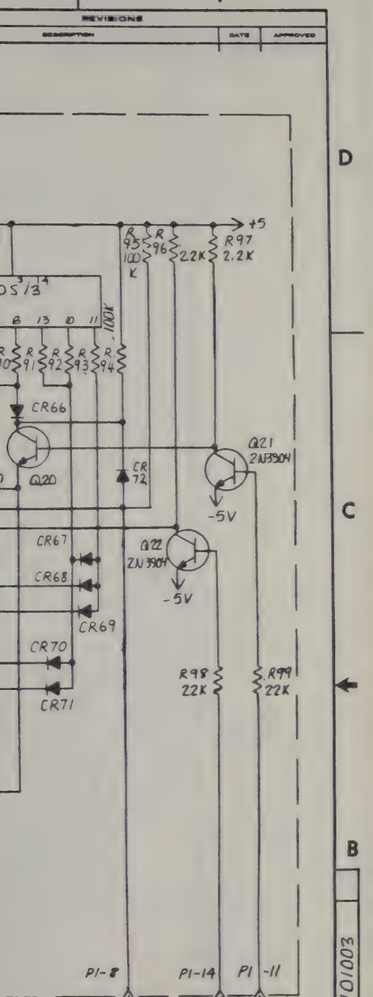
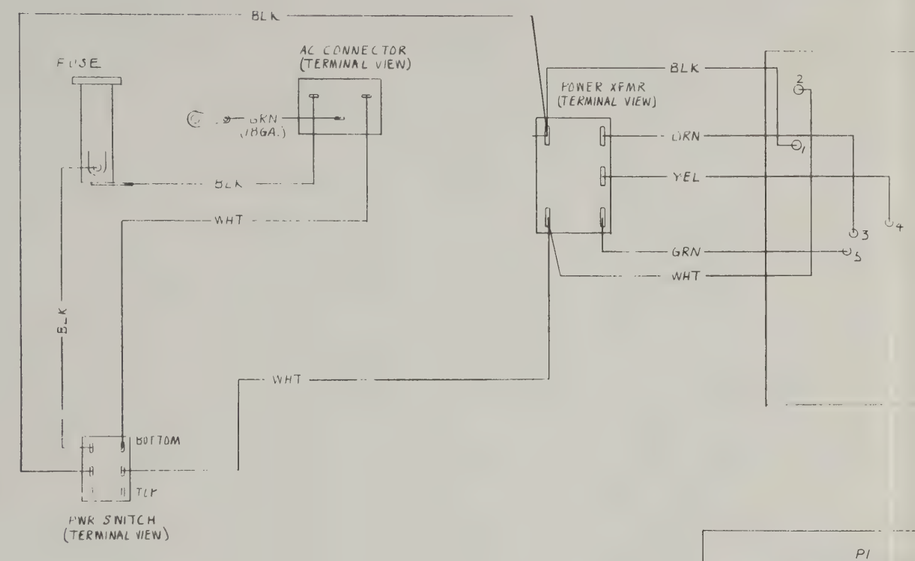
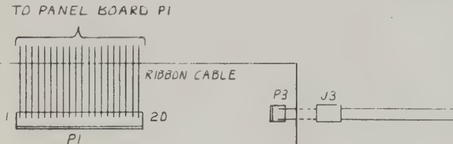
VU-DATA CORPORATION

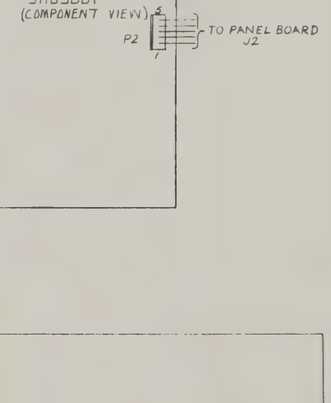
REVISIONS

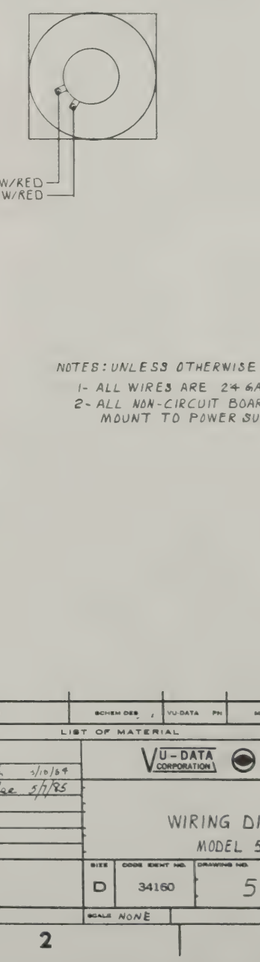
REV	DESCRIPTION	DATE	APPROVED

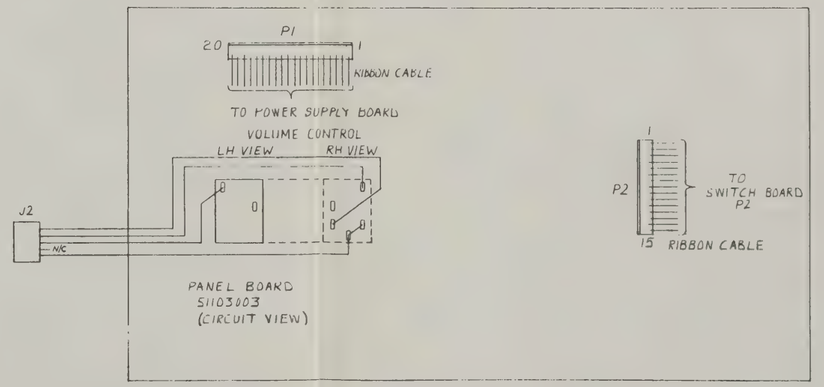


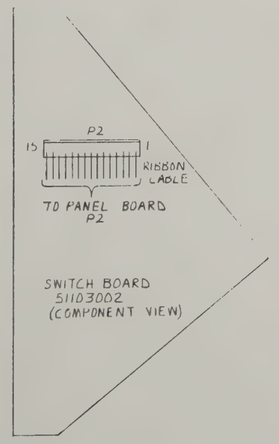












NOTES: UNLESS OTHERWISE SPECIFIED
1- ALL WIRES ARE 24 GA.
2- ALL NON-CIRCUIT BOARD COMPONENTS MOUNT TO POWER SUPPLY BRACKET

ITEM NO	QTY REQD	DESCRIPTION	SCHEM DES	VU-DATA PN	MIL OR VENDOR PN	CODE OR SPEC NO

LIST OF MATERIAL

PART NO	QTY REQD	NEXT ASSEMBLY	USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ±
DECIMALS .X ± .030
.XX ± .030
ANGLES ±
SURFACE FINISH ✓
.XXX ± .010
MATERIAL
FINISH

CONTRACT NO.
DRAWN M S Miller 3/10/89
CHECKED J G Lee 5/1/85
ENGINEER
APPROVED
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE

VU-DATA CORPORATION SAN DIEGO, CALIFORNIA

WIRING DIAGRAM
MODEL 5110

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	34160	51101008	

SCALE NONE SHEET 1 OF 1

SCHEM DES	VU-DATA PN	MIL OR VENDOR PN	CODE OR SPEC NO

OF MATERIAL

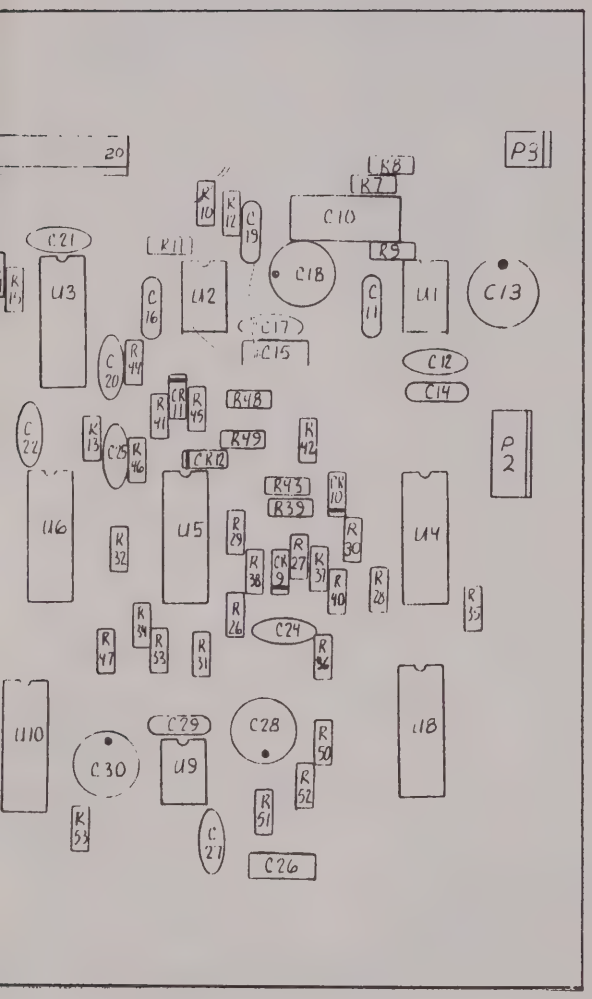
VU-DATA CORPORATION SAN DIEGO, CALIFORNIA

SCHEMATIC
PANEL BOARD. GO/NO-GO

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	34160	51101003	

SCALE NONE SHEET 2 OF 2

5110103



REVISIONS

REV	DESCRIPTION	DATE	APPROVED

ITEM NO	QTY REQD	DESCRIPTION	SCHEM DES	VU DATA PN	MIL OR VENDOR PN	CODE OR SPEC NO

LIST OF MATERIAL

PART NO	QTY REQD	NEXT ASSEMBLY	USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ± DECIMALS .X ± .050
ANGLES ± .XX ± .030
SURFACE FINISH ✓ .XXX ± .010
MATERIAL
FINISH

CONTRACT NO.
DRAWN C. Pruett 4-3-78
CHECKED R. W. A. 5.0 84
ENGINEER
APPROVED
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE

VU-DATA CORPORATION SAN DIEGO, CALIFORNIA

POWER SUPPLY SUB-ASSY

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	34160	51103001	

SCALE 2/1 SHEET 1 OF 1

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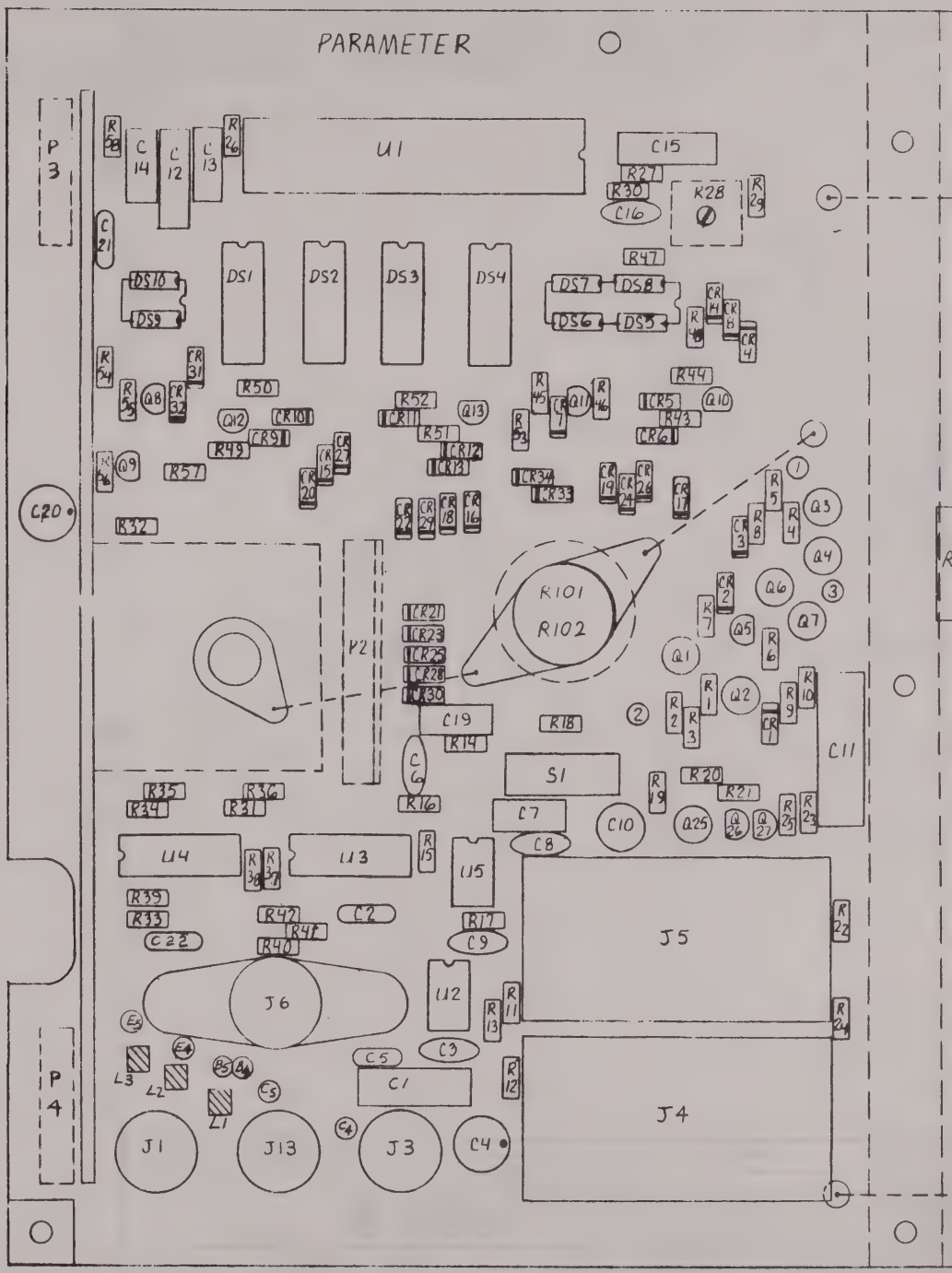
VU DATA CORPORATION



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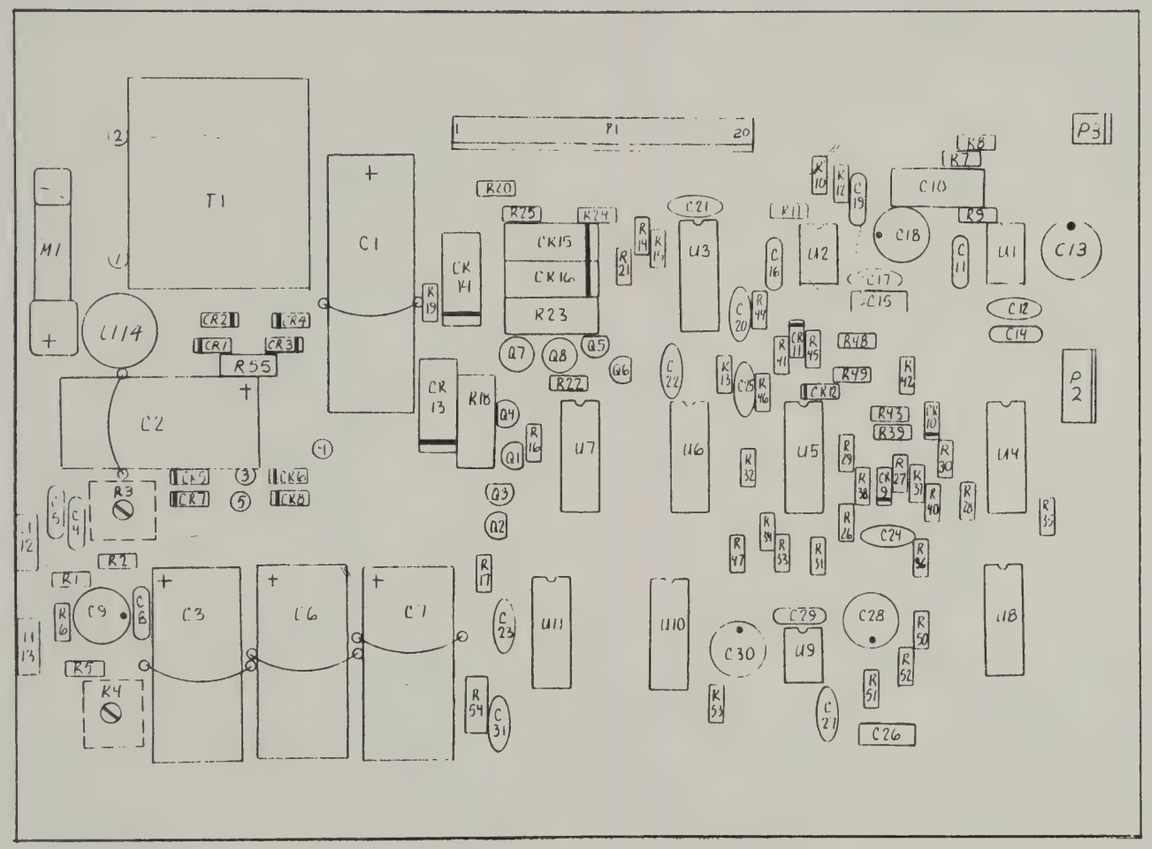
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



ITEM NO	QTY REQD	DESCRIPTION	SCHEM DES	VU DATA PN	MIL OR VENDOR PN	CODE OR SPEC NO

LIST OF MATERIAL

PART NO	QTY REQD	NEXT ASSEMBLY	USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS .X ± .030
ANGLES ± .XX ± .030
SURFACE FINISH ✓ .XXX ± .010
MATERIAL

FINISH

CONTRACT NO.
DRAWN C. Pimentel 4-1-74
SHEERED R.U.A. 5-10-74
ENGINEER
APPROVED
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE

VU-DATA CORPORATION SAN DIEGO, CALIFORNIA

POWER SUPPLY SUB-ASSY

SIZE	CODE IDENT. NO.	DRAWING NO.	REV
D	34160	51105001	

SCALE 2/1 SHEET 1 OF 1

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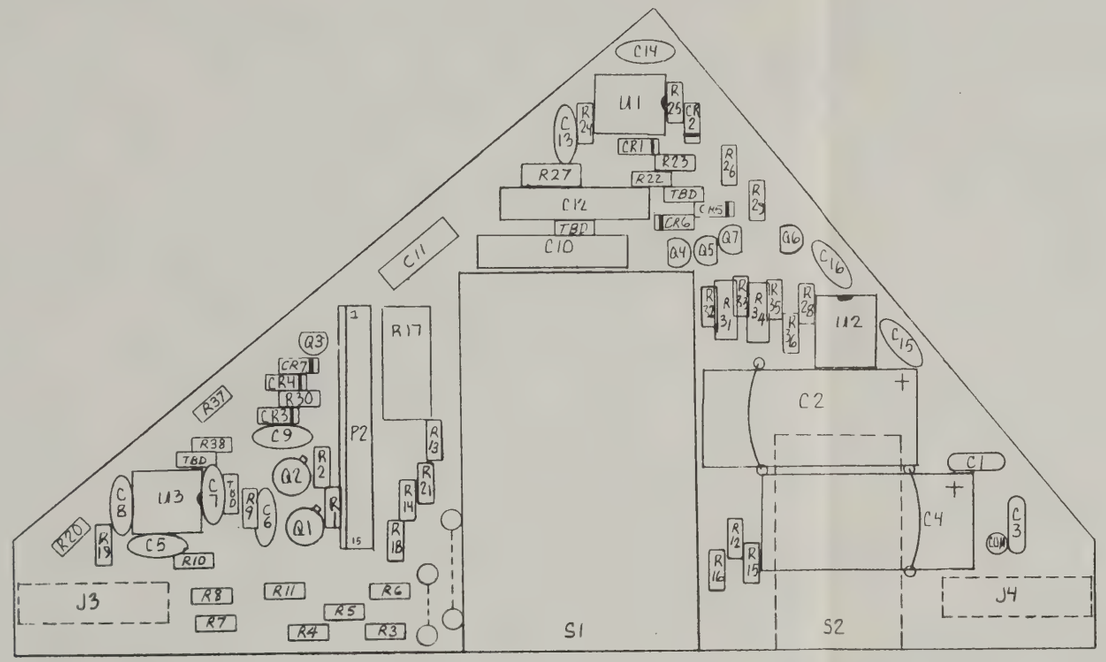
VU-DATA CORPORATION

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



ITEM NO	QTY REQD	DESCRIPTION	SCHEM DES	VU-DATA PN	MIL OR VENDOR PN	CODE OR SPEC NO

LIST OF MATERIAL

PART NO	QTY REQD	NEXT ASSEMBLY	USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS .X ±.050
ANGLES ± .XX ±.030
SURFACE FINISH ✓ .XXX ±.010
MATERIAL
FINISH

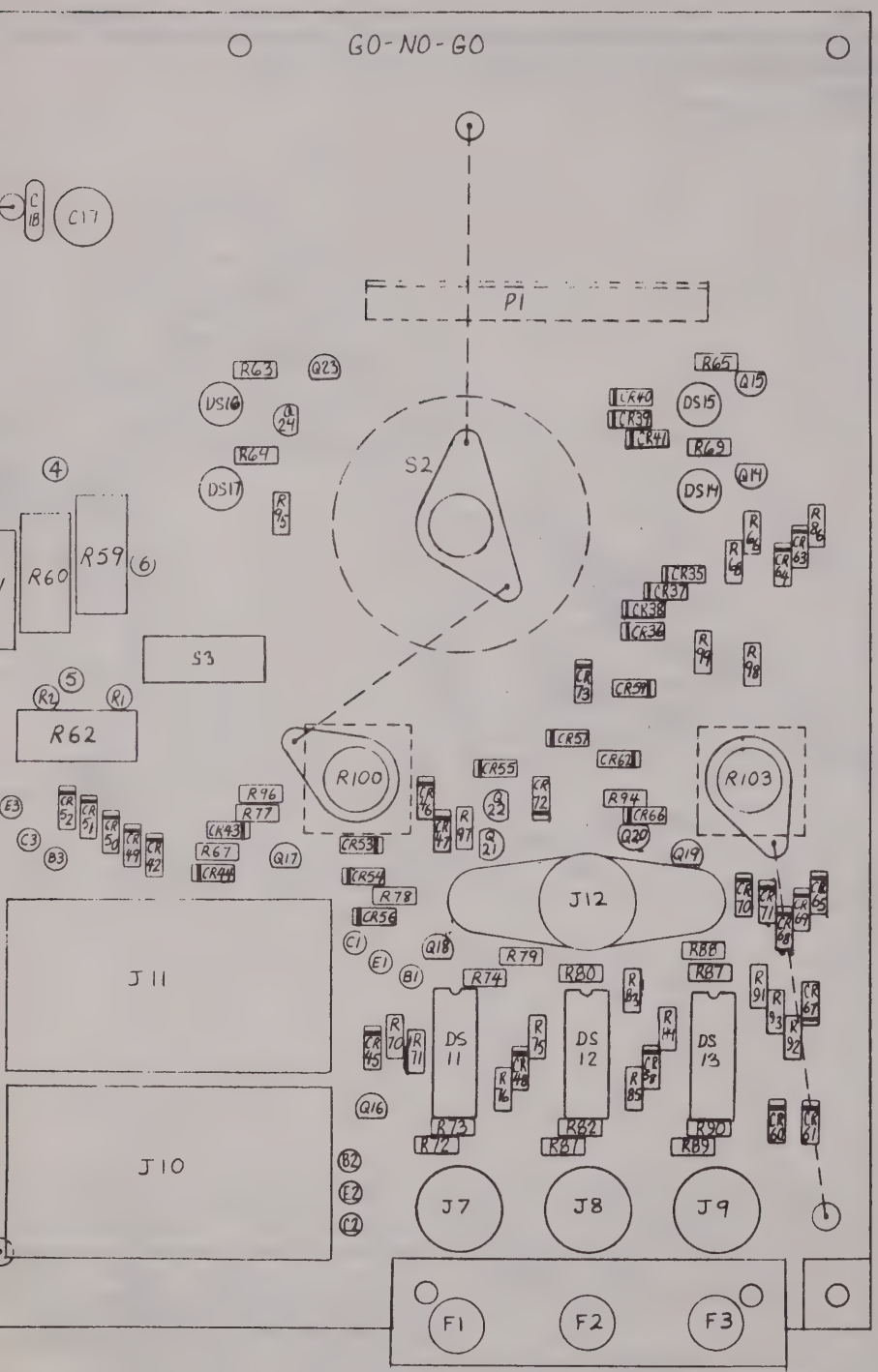
CONTRACT NO.
DRAWN C Probst 84-3-11
CHECKED R. W. A 84 3-15
ENGINEER
APPROVED
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE

VU-DATA CORPORATION SAN DIEGO, CALIFORNIA

ASSY
SWITCH BOARD

SIZE	CODE IDENT NO.	DRAWING NO.	REV
C	34160	51105002	

SCALE 2/1 SHEET 1 OF 1



REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

ITEM NO	QTY REQD	DESCRIPTION	SCHEM DES	VU-DATA PN	MIL OR VENDOR PN	CODE OR SPEC NO

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS .X ± .050
ANGLES ± .XX ± .050
SURFACE FINISH ✓ .XXX ± .010
MATERIAL
FINISH

PART NO	QTY REQD	NEXT ASSEMBLY	USED ON
APPLICATION			

CONTRACT NO.
DRAWN C.H. 3-10-89
CHECKED R W A 3-15-89
ENGINEER
APPROVED
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE

VU-DATA CORPORATION SAN DIEGO, CALIFORNIA

ASSY PANEL BOARD

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	34160	51105003	

SCALE 2 : 1 SHEET 1 OF 1

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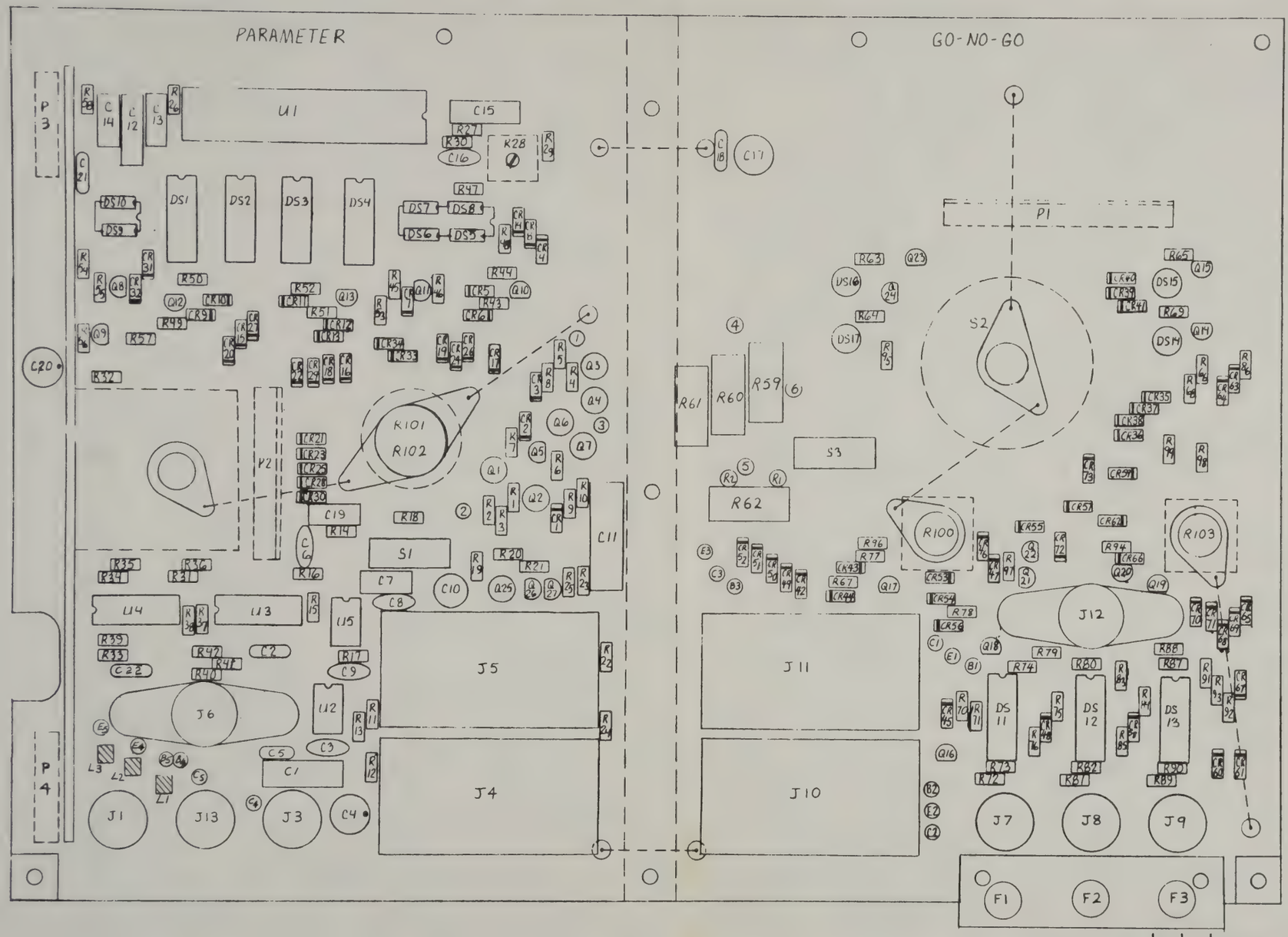
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



ITEM NO	QTY REQD	DESCRIPTION	SCHEM DES	VU DATA PN	MIL OR VENDOR PN	CODE OR SPEC NO

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS .X ± .050
ANGLES ± .XX ± .030
SURFACE FINISH ✓ .XXX ± .010
MATERIAL
FINISH

PART NO	QTY REQD	NEXT ASSEMBLY	USED ON
APPLICATION			

CONTRACT NO.
DRAWN C.H. 3-10-84
CHECKED R W A 3-15-84
ENGINEER
APPROVED
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE

VU-DATA CORPORATION — SAN DIEGO, CALIFORNIA

ASSY
PANEL BOARD

SIZE	CAGE IDENT NO.	DRAWING NO.	REV
D	34160	51105003	

SCALE 2:1 SHEET 1 OF 1

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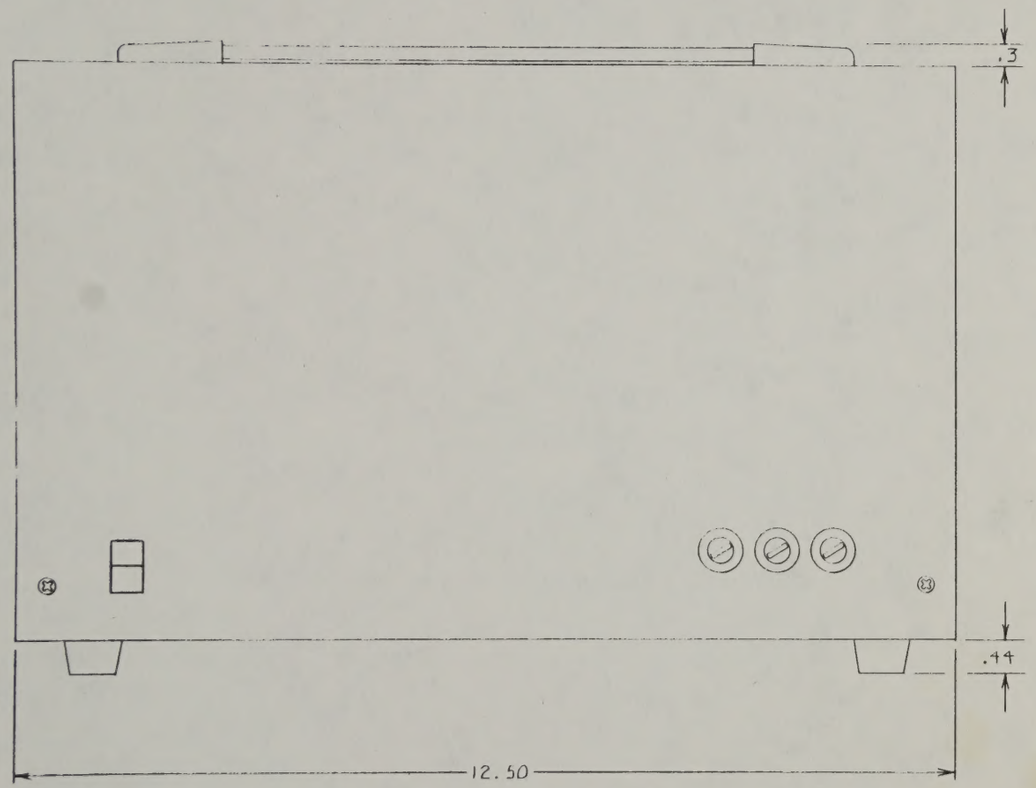
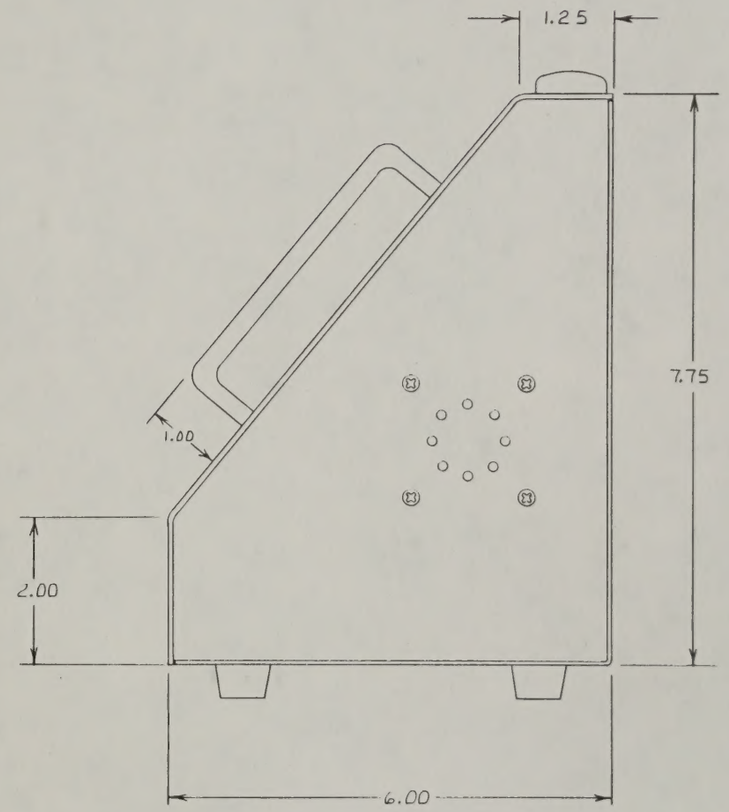
VU-DATA CORPORATION

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	HANDLE 1.00 WAS 1.50	3/6/85	W. F. Mallk





ITEM NO.	QTY REQD	DESCRIPTION	SCHEM DES	VU-DATA PN	MIL OR VENDOR PN	CODE OR SPEC NO.

LIST OF MATERIAL

PART NO.	QTY REQD	NEXT ASSEMBLY	USED ON

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS .X ± .030
ANGLES ± .XX ± .030
SURFACE FINISH ✓ .XXX ± .010
MATERIAL
FINISH

CONTRACT NO.
DRAWN W. F. Mallk 3/18/84
CHECKED
ENGINEER W. F. Mallk 3/18/84
APPROVED
APPROVED R. W. A. 3/19/85
APPROVED
CUSTOMER APPROVAL
RELEASE

VU-DATA CORPORATION — SAN DIEGO, CALIFORNIA

OUTLINE DRAWING MODEL 5110

SIZE	CAGE IDENT NO.	DRAWING NO.	REV
D	34160	51105007	A

SCALE 1/1 SHEET 1 OF 1

TECHNICAL MANUAL

VU-DATA CORPORATION

7122 CONVOY COURT • SAN DIEGO, CALIFORNIA 92111
TELEPHONE: (619) 279-6572
TWX/TLX: 910-335-1586
CABLE: VUDATA SANDIEGO

PUBLICATION NO. 4-20413